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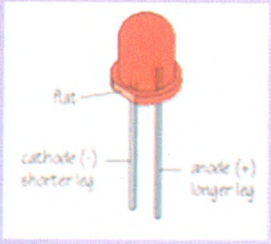
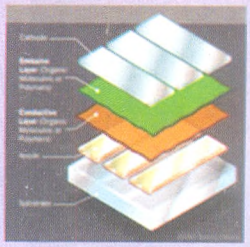
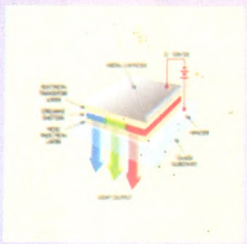
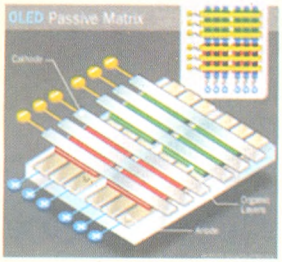


Schematic diagram of OLED and LED

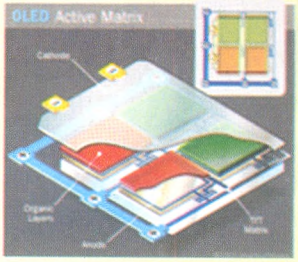




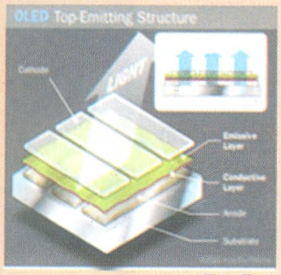
The OLED Structure

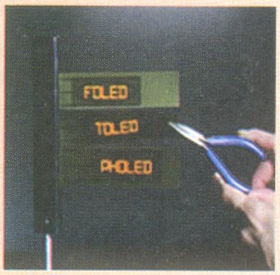


Passive Matrix OLED

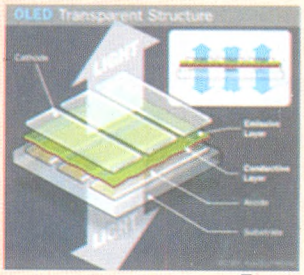


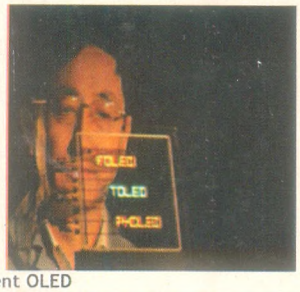
Active Matrix OLED





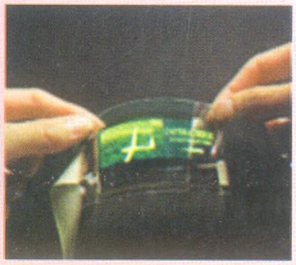
Top Emitting OLED





Transparent OLED

White OLED

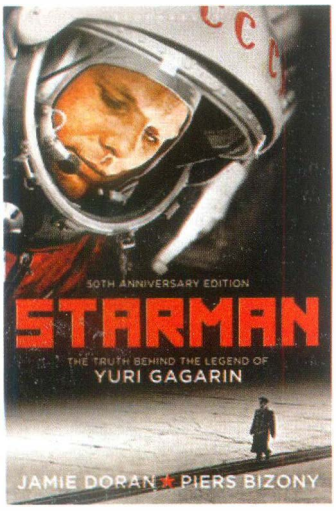


Flexible OLED

Challenges and Future Prospects of Organic Light Emitting Devices

BOOK OF THE MONTH

Starman: the Truth Behind the Legend of Yuri Gagarin



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Author	Piers Bizony, Jamie Doran
Pages	256
Publisher	Walker & Amp Company
Published	April 12, 2011
Price	$16.00
ISBN	10: 0802779506

This April saw the 50th anniversary of the most important event in all of human history: the first time any of us left the planet. On April 12, 1961, cosmonaut Yuri Gagarin pierced Earth's thin shell of atmosphere to boldly go where no one had gone before. Yuri orbited the earth once in the Vostok 1, taking 108 minutes. Back on the ground, his smiling face captured the hearts of millions around the globe. Film stars, politicians and pop stars from Europe to Japan, India to the United States vied with each other to shake his hand.

Despite this immense fame, almost nothing is known about Gagarin or the exceptional people behind his dramatic space flight. Starman tells for the first time Gagarin's personal odyssey from peasant to international icon, his subsequent decline as his personal life began to disintegrate under the pressures of fame, and his final disillusionment with the Russian state. Putting an American on the Moon was a direct reaction to Gagarin's achievement, yet before that successful moonshot occurred, Gagarin himself was dead, aged just thirty-four, killed in a mysterious air crash.

Entwined with Gagarin's history is that of the breathtaking and highly secretive Russian space programme - its technological daring, its triumphs and disasters. In a gripping account, Jamie Doran and Piers Bizony reveal the astonishing world behind the scenes of the first great space spectacular, and how Gagarin's flight came frighteningly close to destruction. There are any number of theories about Gagarin's death, and the conspiracy theorists have bandied about the possibility that the crash wasn't exactly an accident.

Piers Bizony is the author of the award-winning 2001: Filming the Future a detailed account of the making of Stanley Kubrick's film, The Rivers of Mars: Searching for the Cosmic Origins of Life and Island in the Sky: Building the International Space Station. Jamie Doran of Atlantic Celtic Films is an international award-winning documentary producer. After seven years at BBC Television, he went into independent production, where many of his films have concentrated on lifting the lid of secrecy within the former Soviet Union.

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Editorial

Organic LED (light-emitting diode) is a display technology based on the use of an organic substance, typically a polymer, as the semiconductor material in light-emitting diodes (LEDs). A polymer can be a natural or synthetic substance and macro or micro in size. An OLED is a light-emitting diode (LED) in which the emissive electroluminescent layer is a film of organic compounds which emit light in response to an electric current. This layer of organic semiconductor material is situated between two electrodes. Generally, at least one of these electrodes is transparent. Examples of organic polymers include proteins and DNA. OLED technology was pioneered at Kodak, by Dr. Ching W. Tang. When an electrical current is applied to this structure, it emits a bright light. Because OLED displays don't require backlighting, they can be thinner and weigh less than other display technologies. OLED displays also have a wide viewing angle - up to 160 degrees even in bright light - and use only two to ten volts to operate.

OLED displays are used in televisions, laptop and desktop computers, cellular phones, digital video cameras, DVD players, PDAs (personal digital assistants) and car stereos. New technologies that build on the OLED include the FOLED (flexible organic light-emitting display), which promises to bring portable, roll-up displays to the consumer market within the next few years. According to market analysts DisplaySearch, OLED display revenues will grow to $4.5 B by 2011, up from $0.5 B in 2006.

The future of OLED is bright. The Cover Story of this issue of Science India is "Challenges and Future Prospects of Organic Light Emitting Devices".

Team Science India

Challenges and Future Prospects of Organic Light Emitting Devices

N. Divia and Dr. K.R. Haridas

Introduction

The field of organic electronics is evolving rapidly. Driven by many promising commercial applications such as inexpensive photovoltaic cells, better flat panel displays, inexpensive large-area circuits and sensors, research is carried out in many areas that range from theory to organic electronic system. Organic light emitting diodes (OLED) is a promising new technology that can be used to build large, thin and flexible displays. Instead of filtering light like LCDs, OLEDs emit light, which increases the contrast, decreases the response time and eliminates the need for back-lights. Thus we can make thinner digital flat panel displays with better picture quality. A light-emitting diode, usually called a LED, is a semiconductor diode that emits incoherent narrow-spectrum of light when electrically biased in the forward direction of the p-n junction. This effect is a form of electroluminescence.

A light-emitting diode, usually called a LED, is a semiconductor diode that emits incoherent narrow-spectrum of light when electrically biased in the forward direction of the p-n junction. This effect is a form of electroluminescence.

If the emitting layer material of the LED is an organic compound it is known as an OLED. An OLED is an electronic device made by placing a series of organic thin films between two conductors. When electrical current is applied, a bright light is emitted. A device that is 100 to 500 nanometers thick or about 200 times smaller than a human hair. To function as a semiconductor, the organic emitting material must have conjugated pi bonds. The emitting material can be a small organic molecule in a crystalline phase or a polymer. The motivations in using organic active materials come from their ease in tuning electronic and processing properties by chemical design and synthesis, low cost processing based on low temperature processes, reel-to-reel printing methods, mechanical flexibility and compatibility with

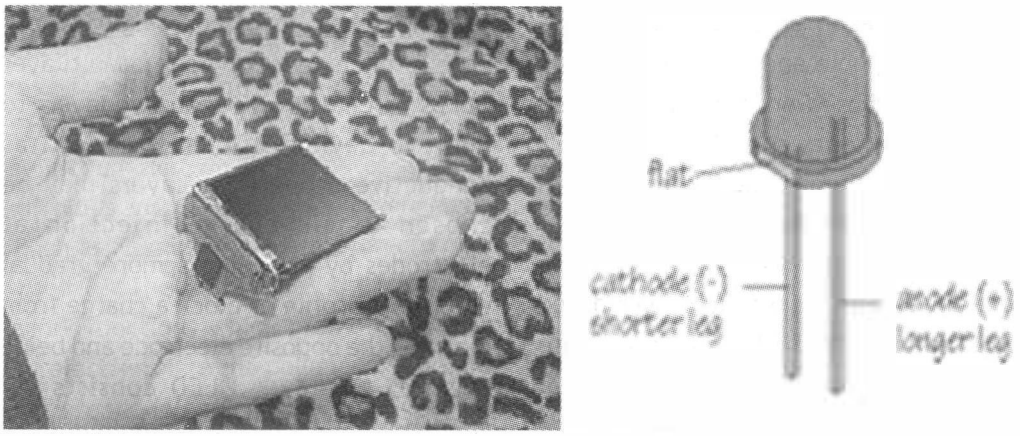

Fig. 1. Schematic diagram of OLED and LED

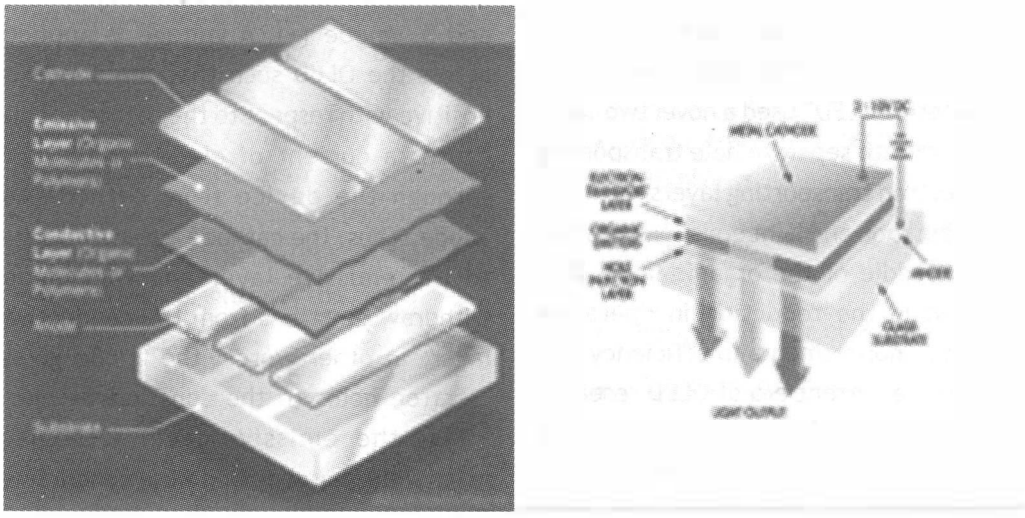

Fig. 2. The OLED Structure

flexible substrates. Flexible electronic circuits, displays and sensors based on organic active materials will enable future generation of electronic products that may eventually enter the mainstream electronics market.

History of OLED

Bernanose and co-workers (1953) at the Nancy-University, first observed electroluminescence in organic materials in the early 1950s by applying high-voltage alternating current (AC) fields in air to acridine orange and quinacridine. In 1960, Martin Pope and his group made the seminal discovery of ohmic, dark injecting electrode contacts to organic crystals and described the necessary energetic requirements (work functions) for hole and electron injecting electrode contacts. In 1963, Martin Pope and his group first observed direct current (DC) electroluminescence under vacuum on a pure single crystal of anthracene and also on anthracene crystal doped with tetracene. Also in 1965, W. Helfrich and W.G. Schneider produced double injection recombination electroluminescence for

the first time in an anthracene single crystal using hole and electron injecting electrodes whose work functions satisfied the requirements specified by Pope's group. Electroluminescent materials can be insulators or doped insulators. The Helfrich and Schneider paper is the forerunner of all double injection induced OLED devices. The first attempt to create a polymer LED was by Roger Partridge at the UK's National Physical Laboratory. The first diode device was invented at Eastman Kodak by Ching W. Tang and Steven Van Slyke in the 1980s. This diode, giving rise to the term "OLED" used a novel two-layer structure with separate hole transporting and electron transporting layers such that recombination and light emission occurred in the middle of the organic layer. This resulted in the reduction in operating voltage, improvements in efficiency and started the current era of OLED research and device production. Later, this concept was adapted for use with polymers which culminated in the Burroughes *et al.* 1990 paper reporting a very high-efficiency green light emitting polymer.

Working principle

A typical OLED is composed of an emissive layer, a conductive layer, a substrate, anode and cathode terminals. The layers are made up of organic molecules that conduct electricity. The layers have conductivity levels ranging from insulators to conductors, so OLEDs are considered organic semiconductors. The first, most basic OLEDs consisted of a single organic layer, for example the light-emitting polymer device synthesized by Burroughs *et al.* involved a single layer of poly (p-phenylene vinylene). Multilayer OLEDs can have more than two layers to improve device efficiency as well as conductive properties. Layers may be chosen to aid charge injection at electrodes by providing a more gradual electronic profile or block a charge from reaching the opposite electrode and being wasted. A 2-layer OLED consists of: 1.Cathode (-), 2. Emissive Layer, 3. Emission of radiation, 4. Conductive Layer and 5. Anode (+). A voltage is applied across the OLED such that the anode is positive with respect to the cathode. This causes a current of electrons to flow through the device from cathode to anode. Thus, the cathode gives electrons to the emissive layer and the anode withdraw electrons from the conductive layer; in other words, the anode gives electron holes to the conductive layer. Soon, the emissive layer becomes negatively charged, while the conductive layer becomes rich in positively charged holes. Electrostatic forces bring the electrons and the holes towards each other and they recombine. This happens closer to the emissive layer, because in organic semiconductors holes are more mobile than electrons. The recombination causes a drop in the energy levels of electrons, accompanied by an emission of radiation whose frequency is in the visible region. That is why this layer is called emissive. The device does not work when the anode is put at a negative potential with respect to the cathode. In this condition, holes move to the anode and electrons to the cathode, so they are

moving away from each other and do not recombine. Indium tin oxide is commonly used as the anode material. It is transparent to visible light and has a high work function which promotes injection of holes into the polymer layer. Metals such as aluminium and calcium are often used for the cathode as they have low work functions which promote injection of electrons into the polymer layer. Large difference in energy between HOMO and the anode work function or the LUMO and the cathode work function, causes charge injection to be poor. Colour of the emitted light depends upon the type of organic molecule in the emissive layer. Dopants are added for different colours. Intensity or brightness of the colour depends on the amount of electric current applied. More the current, brighter is the light.

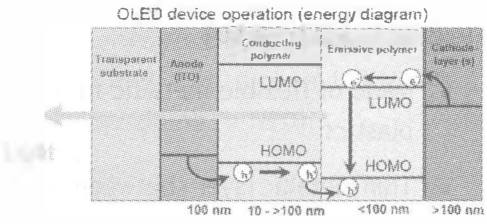

Fig. 3. OLED device operation

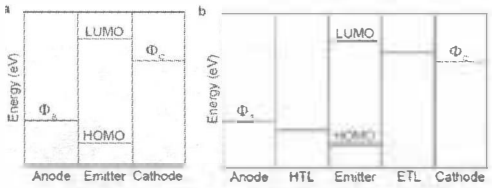

Fig. 4. Energy - level diagram

Classification of OLEDs

I Based on current driving method used, OLEDs are classified as: i) Passive matrix OLED [PMOLED], and ii) Active matrix OLED [AMOLED]

II Based on structure and purpose, they are classified as: i) Transparent OLED [TOLED], ii) Top emitting OLED, iii) Flexible OLED [FOLED], and iv) White OLED.

Passive Matrix OLED [PMOLED]

- Organic material is sandwiched in between strips
- Intersection of anode and cathode - pixel
- Organic material emit light when electricity is applied to desired row and column lines
- Huge driving current for average brightness
- Brightness directly proportional to current
- More power for operation
- Good for text and icons
- Used in small screen devices like PDAs

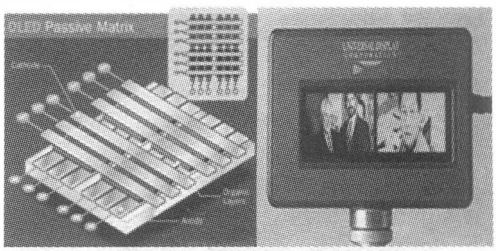

Fig. 5. Passive Matrix OLED

Active Matrix OLED [AMOLED]

- Gives the same quality display as PMOLED
- Anode layer overlays a TFT layer
- Consumes less power
- TFT matrix is the circuitry that

determines which pixel should be turned on

- Two transistors and capacitor per pixel
- TFT array controls the current; thereby the brightness
- Applications - computer monitors, large screen TVs and electronic signs

Fig. 6. Active Matrix OLED

Top Emitting OLED

- Substrate - opaque or reflecting
- Suited for active matrix design
- Used in automobile in speedometer, display units and smart cards

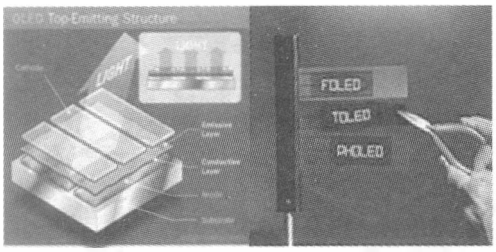

Fig 7. Top Emitting OLED

Transparent OLED

- Substrate, cathode and anode transparent
- Transparency - 75% when not working
- Used in automobile windshields

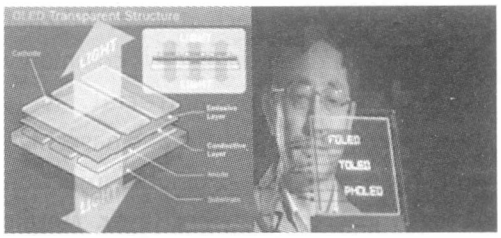

Fig. 8. Transparent OLED

White OLED

- Emits white light with high intensity
- Can replace other lamps
- Made in large sheets
- Used for general lighting

Fig. 9. White OLED

Flexible OLED [FOLED]

- Made of flexible metallic foils and plastics
- Thin metallic layer - between pixels
- Used in curved helmet face shields
- Used in fabrics

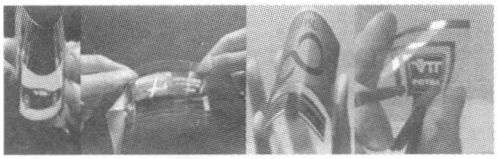

Fig. 10. Flexible OLED

Organic Materials used in OLED

Based on the use of organic compounds OLED is differentiated into small molecule OLED and polymer OLED. Alq3 [Tris-(8 hydroxy quinoline) aluminium] is commonly used as both electron

transporting and electron injecting layer in small molecule OLEDs. Typical polymers used in OLED displays include derivatives of poly (p-phenylene vinylene) and polyfluorene. Materials based on arylamines have been extensively studied due to their interesting physical, photochemical, and electrochemical properties. These materials tend to form uniform amorphous layers, are highly luminescent chromophores, and can form stable radical cations without undergoing subsequent chemical transformations. Consequently, this class of materials has been widely exploited as hole-transport layers in organic light emitting diodes (OLEDs). In fact, the most commonly used hole transporting materials for OLED applications are arylamine-based compounds, including N,N'-2-diphenyl-N,N'-bis-m-tolylbenzidine (TPD), 4,4',4''-tris (diphenylamino) triphenylamine (TDATA) and N,N'-diphenyl-N,N'-bis-á-napthylbenzidine (α-NPD).

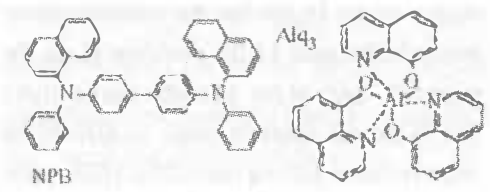

Fig. 11 Structure of compounds commonly used for OLEDs

Another advantage to arylamine-based materials is the recent advances in their synthesis. Over the last ten years, Hartwig and Buchwald have independently developed highly active palladium catalysts for the coupling of aryl amines to aryl halides. With high yields, mild conditions, and a tolerance for a wide range of functional groups, this chemistry has made the synthesis of most arylamine-based materials relatively simple. Even more recently, our group and others have reported the ability to do similar coupling reactions using copper catalysts, making these reactions affordable as well as efficient. With all of the associated advantages of arylamines, we have set out to develop new electronic materials based on these systems.

Making of OLEDs

The biggest part of manufacturing OLEDs is applying the organic layers to the substrate. This can be done in three ways:

Vacuum deposition or vacuum thermal evaporation (VTE) - In a vacuum chamber, the organic molecules are gently heated (evaporated) and allowed to condense as thin films onto cooled substrates. This process is expensive and inefficient.

Organic vapor phase deposition (OVPD) - In a low-pressure, hot-walled reactor chamber, a carrier gas transports evaporated organic molecules onto the cooled substrates, where they condense into thin films. Using a carrier gas increases the efficiency and reduces the cost of making OLEDs.

Inkjet printing - With inkjet technology, OLEDs are sprayed onto substrates just like inks are sprayed onto paper during printing. Inkjet technology greatly reduces the cost of OLED manufacturing and allows OLEDs to be printed onto very large films for large displays like 80-inch TV screens or electronic billboards.

Potential of OLEDs

Today, OLEDs operate at substantially

lower efficiency than inorganic (crystalline) LEDs. The best luminous efficiency of an OLED so far is about 10% of the theoretical maximum of 683, or about 68 lm/W. These claim to be much cheaper to fabricate than inorganic LEDs, and large arrays of them can be deposited on a screen using simple printing methods to create a color graphical display. Compared with regular LEDs, OLEDs are lighter, and polymer LEDs can have the added benefit of being flexible. Some possible future applications of OLEDs could be inexpensive, flexible displays, light sources, Wall decorations and luminous cloth. OLEDs have been used to produce visual displays for portable electronic devices such as cell phones, digital cameras, and MP3 players. Organic light-emitting devices have shown potential to be low-cost, full color flat panel displays due to their merits of high brightness, easy fabrication, and the availability of a wide range of emission colors. The past decade has seen great progress in both device fabrication techniques and material developments. One of the key developments has been made by Tang and VanSlyke (1987) who demonstrated that the use of hole-transporting layers (HTLs) for hole injection from the anodes into the light-emitting layer provides a significant improvement of the OLED device performance. Since then much attention has been paid for developing the new hole-transporting materials. In particular, low molecular weight amorphous materials have received interest as candidates for HTL materials due to their easy purification by vapor deposition or column chromatographic techniques and uniform thin film can be simply processed by coating techniques.

Advantages of OLED

The LCD is currently the display of choice in small devices and is also popular in large-screen TVs. Regular LEDs often form the digits on digital clocks and other electronic devices. OLEDs offer many advantages over both LCDs and LEDs. The plastic, organic layers of an OLED are thinner, lighter and more flexible than the crystalline layers in an LED or LCD. Because the light-emitting layers of an OLED are lighter, the substrate of an OLED can be flexible instead of rigid. OLED substrates can be plastic rather than the glass used for LEDs and LCDs. OLEDs are brighter than LEDs. Because the organic layers of an OLED are much thinner than the corresponding inorganic crystal layers of an LED, the conductive and emissive layers of an OLED can be multi-layered. Also, LEDs and LCDs require glass for support, and glass absorbs some light. OLEDs do not require glass. OLEDs do not require backlighting like LCDs. LCDs works by selectively blocking areas of the backlight to make the images that you see, while OLEDs generate light themselves. Because OLEDs do not require backlighting, they consume much less power than LCDs (most of the LCD power goes to the backlighting). This is especially important for battery-operated devices such as cell phones. OLEDs are easier to produce and can be made to larger sizes. Because OLEDs are essentially plastics,

they can be made into large, thin sheets. It is much more difficult to grow and lay down so many liquid crystals. OLEDs have large fields of view, about 170 degrees. Because LCDs work by blocking light, they have an inherent viewing obstacle from certain angles. OLEDs produce their own light, so they have a much wider viewing range. OLEDs offer greater color fidelity. OLED panels exhibit 16.78 million colors (24-bit colors). OLEDs are much cheaper to fabricate than inorganic LEDs.

Problems with OLED

OLED seems to be the perfect technology for all types of displays but it also has some problems like:

Lifetime - While red and green OLED films have longer lifetimes (46,000 to 230,000 hours), blue organics currently have much shorter lifetimes (up to around 14,000 hours).

Manufacturing - Manufacturing processes are expensive right now.

Water - Water can easily damage OLEDs

Mobility - Low mobility due to amorphous nature of the organic molecules.

Current and Future OLED Applications

Currently, OLEDs are used in small-screen devices such as cell phones, PDAs and digital cameras. In September 2004, Sony Corporation announced that it was beginning mass production of OLED screens for its CLIE PEG-VZ90 model of personal entertainment handhelds. Kodak was the first to release a digital camera with an OLED display in March 2003, the

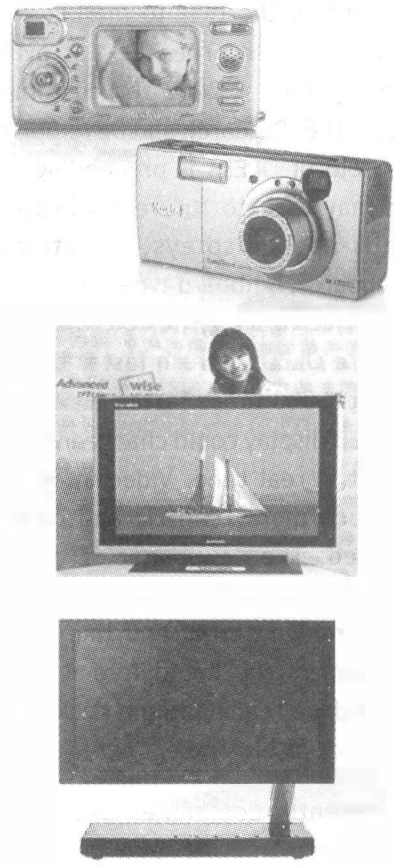

Fig. 12. Current OLED

Easy Share LS633. Several companies have already built prototype computer monitors and large-screen TVs that use OLED technology. In May 2005, Samsung Electronics announced that it had developed a prototype 40-inch, OLED-based, ultra-slim TV, the first of its size. And in October 2007, Sony announced that

Fig. 13. Future of OLED

it would be the first to market with an OLED television. The XEL-1 is available from December 2007 for customers in Japan. U.S. Research and Development in the field of OLEDs is proceeding rapidly and may lead to future applications in heads-up displays, automotive dashboards, billboard type displays, home and office lighting, flexible displays etc. Because OLEDs refresh faster than LCDs, almost 1,000 times faster, a device with an OLED display could change information almost in real time. Video images could be much more realistic and constantly updated. The newspaper of the future might be an OLED display that refreshes with breaking news and like a regular newspaper, you could fold it up when you're done reading it and stick it in your backpack or briefcase.

Presently companies like Samsung, Sony and DuPont are using OLED technology to a large extent.

Samsung applications

As of 2004, Samsung South Korea's largest conglomerate was the world's largest OLED manufacturer producing 40% of the OLED displays made in the world. Samsung also held the world's largest market share in both Passive Matrix OLEDs and Active Matrix OLEDs. It was also the first company in the industry to develop and manufacture AMOLED displays. In January 2005, Samsung SDI, a subsidiary of Samsung Group, announced the world's largest OLED TV of the time, at 21 inches (53 cm). This OLED featured the highest resolution of 2.3 million pixels. As of 2006, it held more than 600 American patents and more than 2800 international patents, making it the largest owner of AMOLED technology patents. In January 2008, Samsung showcased the world's largest and thinnest OLED TV of the time, at 31 inches and 4.3 mm. In May 2008, Samsung unveiled an ultra-thin 12.1 inch laptop OLED display concept, with a 1,280×768 resolution with infinite contrast ratio. In October 2008, Samsung showcased the world's thinnest OLED display, also the first to be flappable and bendable. It measures just 0.05 mm (thinner than paper). Also in October 2008, Samsung unveiled what was then the world's largest OLED Television at 40-inch with a Full HD resolution of 1920 × 1080 pixel. In April 2009, Samsung released its first phone using the AMOLED display in the United States. In January 2010, Samsung demonstrated a laptop computer with a large, transparent OLED display and an animated OLED display in a photo ID card.

Sony applications

In 2004, Sony released the Sony CLIÉ PEG-VZ90, the first commercial device to feature an OLED screen. In 2006 Sony introduced the MZ-RH1 Portable Minidisc Recorder, which has an OLED screen. At the Las Vegas CES 2007, Sony showcased 11 inch (28 cm, resolution 960 × 540) and 27 inch (68.5 cm, full HD resolution at 1920 × 1080) OLED TV models. In May 2007, Sony publicly unveiled a video of a 2.5-inch flexible OLED screen which is only 0.3 millimeters thick. At the CES 2008, Sony showcased the Walkman X series with 3" OLED touch screen. In April 2008, Sony showed a 0.2 mm (0.0079 inch) thick 3.5 inch display with a resolution of 320 × 200 pixels and a 0.3 mm thick 11 inch display

with 960 × 540 pixels resolution (one-tenth the thickness of the XEL-1). In October 2008, Sony published results of research it carried out with the Max Planck Institute, over the possibility of mass-market bending displays, which could replace rigid LCDs and plasma screens. Eventually, bendable, transparent OLED screens could be stacked to produce 3D images with much greater contrast ratios and viewing angles than existing products.

DuPont applications

In May 2010, DuPont stated in a press release that they can produce a 50-inch OLED T.V. in two minutes with a new printing technology. If this can be scaled up in terms of manufacturing, then the total cost of OLED T.V.'s would be greatly reduced. Dupont also states that OLED T.V.'s made with this less expensive technology can last up to 15 years if left on for a normal eight hour day.

Other manufacturers

Manufacturers of OLED panels include Anwell Technologies Limited, Chi Mei Corporation, LG and others.

Commercial uses

OLED technology is used in commercial applications such as small screens for mobile phones and portable digital audio players (MP3 players), car radios, digital cameras, and high-resolution micro displays for head-mounted displays. Such portable applications favour the high light output of OLEDs for readability in sunlight, and their low power drain. Portable displays are also used intermittently, so the lower lifespan of OLEDs is less important here. Prototypes have been made of flexible and rollable displays which use OLEDs unique characteristics. OLEDs have been used in most Motorola and Samsung colour cell phones, as well as some LG and Sony Ericsson phones, notably the Z610i, and some models of the Walkman. It is also found in the Creative Zen V/V Plus series of MP3 players and Iriver U10/clix. Nokia has also introduced recently some OLED products, including the 7900 Prism, the Nokia 8800 Arte, and the Nokia N85, Nokia N86 8MP, both of which feature an AMOLED display. June 2010, Liquidware (an open-source electronics firm) has released a kit with a 4.3" (480 x 272) OLED touch display, called the Beagle Touch.

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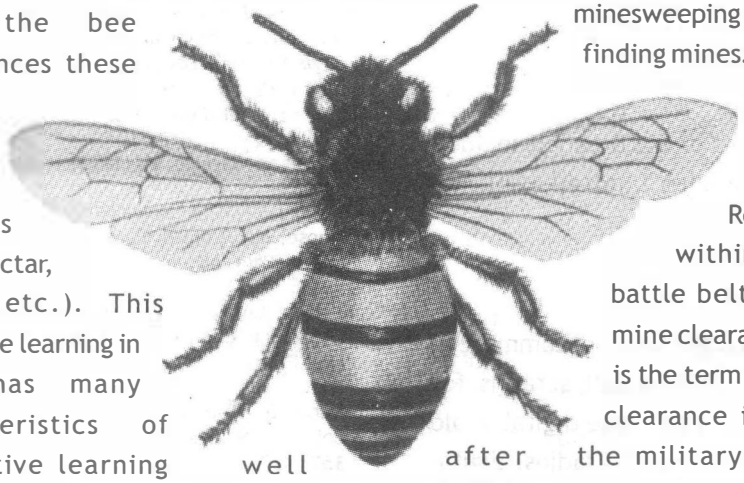
Bees are Soldiers Friends: Role of Bees as Minesweepers

Vibina Venugopal, Roshan James, Dr. K. Subaharan and P. Ravindran

Honey bees are a subset of bees in the genus *Apis*, primarily distinguished by the production and storage of honey and pollination of flowers. Associative learning is an essential component of the bee's central place foraging behavior and dance communication. Hive mates attending a dance performance learn the odor emanating from the dancing bee and seek it at the indicated food site. The odor, colour, shape of flowers etc. are learned when the bee experiences these stimuli shortly before it finds food (nectar, pollen etc.). This appetitive learning in bees has many characteristics of associative learning well known from mammalian learning studies. This olfactory learning of bees can be used to save humans.



Landmines pose a continuous threat to people's life, deny access to land and its resources to the inhabitants near-by, and hence affect progress and rehabilitation process. Besides this, there are immense medical, psychological, economic and environmental consequences to mine victims especially children who are doomed to suffer all their life with terrible physical disabilities. Even animals are not spared from this.

Demining is a process of clearing away mines, from an area, while minesweeping is the action of finding mines. There are two distinct types: military and humanitarian. Removal of mine within progressive battle belt is termed as mine clearance. Demining is the term used when the clearance is carried out after the military activity has declined.

The tools for minesweeping and demining should precisely search out every landmine, unexplored ordnance (UXO), and other buried mine-like objects swiftly and effectively. There are different

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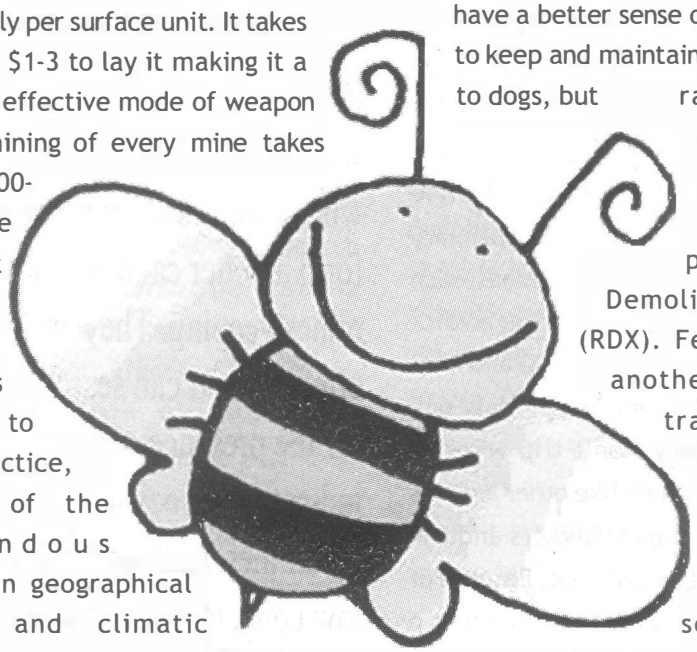
methods of demining technologies that are in use, hand clearance using metasl detectors, forced reaction of TNT (2, 4, 6 Trinitrotoluene) by laser and ion mobility spectroscopy. The laborious process makes it very costly per surface unit. It takes only about $1-3 to lay it making it a cheap and effective mode of weapon while demining of every mine takes about $1000-3000. The development of new demining technologies is difficult to put in practice, because of the tremendous diversity in geographical latitude and climatic conditions, and wide variety of landmines itself. Currently used tools are limited by low sensitivity and operational complexities due to the variety in soil composition, vegetation, mine size and composition, burial depth, grazing angle, and ground clutter and slows down the detection rates to unacceptable levels. It has been recognized that all landmines leak and release small amount of their explosives such as TNT, DNT (Dinitrotoluene), TNB (1, 3, 5 Trinitrobenzene) etc. with time and it can be found in and on the surrounding ground and plant life; these form the primary indicator of a landmine and UXO.

Alternative methods in minesweeping is making use of animals, for instance dogs that can be made use of, to detect the presence of any buried mines but dogs cannot work for long hours. Dogs are not good in detecting the vapours at low concentrations. African giant pouch rats have a better sense of smell, cheaper to keep and maintain when compared to dogs, but rats cannot differentiate between smokeless powder and Royal Demolition Explosive (RDX). Female pigs are another option but training is a laborious process. Apart from animals Bacterial sensors can be harnessed for this purpose eventhough with engineered bacterial biosensors longevity and



reproducibility are'nt fully satisfying and much has'nt been studied about the natural environment in which they thrive well. Hence very little can be predicted on the performance of bacterial biosensors. Genetically engineered plants such as *Arabidopsis thaliana* was developed that could detect Nitrogen dioxide, a product released by landmine. But Nitrous oxide is also produced by denitrifying bacteria and hence give false positive results.

Due to the above limitations of animals, researchers are forced to look in for alternative options like bees (*Apis mellifera*) which is of great interest. Insects have been an effective tool in collecting information, such as the presence of pollutants or trace materials on plants. Bees are independent organisms with appreciable sense of smell and when properly conditioned they form a better candidate for minesweeping. They are also cost effective and can search wide areas for the presence of any primary indicators associated with landmines, such as TNT, at very low concentration, and for other explosive materials in UXO and min-like objects. Since they weigh only one tenth of gram, they won't trip wires or set mines off. Moreover like other animals they don't need human handlers and can be monitored from a distance. Batches of bees, which would consist of thousands o them, can be trained within a very short time for the task of minesweeping. Advantages with the bees are that, they can easily fly over and search a field for explosives without having a direct contact with any mines. Honeybees inhale large quantities of air and bring back water for evaporative cooling of its hive. There are mop-like branched hairs in a honeybee's body that are electro-statically charged and act like a flying dust mop making it as an extremely effective collector of explosive chemical while foraging.

The entomologists from University of Montana indicated the studies on bees during the 1970s. A consortium of Defence Advanced Research Projects Agency (DARPA) was started under the leadership of the University of Montana with Jerry Bromshenk as their Head, who formed a company recently called Bee Alert Technology Inc. The DARPA programme that begun in 1999 brought together a

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team of scientists from the University of Montana, Sandia National Laboratories, Oak Ridge National Laboratories, and Southwest Research Institute to focus on developing bees for use in detecting chemical and biological warfare agents as well as landmines. Partners at Air Force Research Laboratory and the Air Force Protection Laboratory joined the research team in 2000. In addition to this, Nikola Kezic, Professor of Zagreb University in Croatia is also working on honey bees as a solution to find thousands of landmines in Croatia that are results of 1990 war.

The research focused on the use of honey bees to screen large areas for mines and UXOs including the localization of volatile and semi-volatile organic chemicals, radio active materials, explosive materials and landmines. Honey bee carries back the contaminants to the hive where a system is fixed to analyze chemicals found in explosives. This DARPA cooperative programme extends its task to train honey bees to effectively search for primary indicators. The training consists of associating sugar-soaked sponges mixed with traces of TNT to see if bees would swarm to them. When trained, foraging bees locate vapour of the same odor of the trained food, and they would tend to fly until they reach its source. Monitoring bee's location and dwell time throughout a test region, with significant operator stand-off distance well connected with horizontal polarized scanning light detection and ranging (LIDAR) system to detect flying honey bees can provide with substantial results. Members from a single colony make tens of thousands of foraging trips per day over areas as far as 1-2 km.

Man's best friend may indeed be a dog, but if DARPA's research projects prove successful, a soldier's best fried may be the creatures they swat, stop or shoo. All lines of evidence indicate that bees should be able to find real landmines (or at least that leak trace amounts of explosives).

Man's best friend may indeed be a dog, but if DARPA's research projects prove successful, a soldier's best fried may be the creatures they swat, stop or shoo. All lines of evidence indicate that bees should be able to find real landmines (or at least that leak trace amounts of explosives). The missing aspects are experience on real minefields, so that the system can be optimized and thoroughly calibrated. Recent use of tracking such as LIDAR would provide advancement in mapping of minefields. These insects can be programmed to serve as an early warning system for biological weapons.

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Transgenic tomato tested in high altitude, cold arid region of Ladakh

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Environmental insults pose a major threat not only to agriculture and food security but also to nutritional security. While biotic stress in agriculture has been augmented to a greater extent, abiotic stress is relatively in its teething stage. Abiotic stresses such as drought, salinity, extreme temperature and oxidative stress are serious threats to agriculture, resulting in gradual deterioration of the environment. Elucidating the various mechanisms of plant response to stress and their role in acquired stress tolerance is thus of great practical and basic importance.

Of the many crops grown worldwide, vegetables occupy an important portion of our daily diet, not only in quantity but also in quality. As known, vegetables are a rich source of minerals, vitamins, carotenoids, antioxidants etc. which help protect human body from several ailments. The intake of 300-400 g vegetables per capita per day is associated with reduced incidence of many common forms of cancer and diets rich in plant foods are also associated with a reduced risk of heart disease and many chronic diseases of ageing (Mathura Rai and Pandey, 2007). India is the leading vegetable producing country in the world and occupies 6.76 million hectare area with an annual production of 101.43 million tones wherein, tomato (*Lycopersicon esculentum* L.) alone holds for 8.5% of the total produce. The consumption of tomato and tomato products is linked with a decreased risk of cancer and cardiovascular diseases. The actual powerful ingredient of tomatoes responsible for the health benefits is lycopene. The health benefits of lycopene have been attributed to its antioxidant properties, although other mechanisms of lycopene action are possible, including the

The nutritional attributes of tomato are well documented and have been reaped since ages. Common man is fortunate enough to consume fresh tomato unlike our fellow soldiers and army men located at frontier areas like Ladakh struggling with hostile climate for the sake of the country's security.

modulation of intercellular communication, hormonal and immune system changes and enhancement of gap junctional communication. The nutritional attributes of tomato are well documented and have been reaped since ages. Common man is fortunate enough to consume fresh tomato unlike our fellow soldiers and army men located at frontier areas like Ladakh struggling with hostile climate for the sake of the country's security. They are able to consume only those tomatoes that are transported from distance and have low shelf life. In addition, tomato is a crop that is highly susceptible to cold stress and its cultivation at high altitudes is restricted to protected structures in short agricultural seasons.

Ladakh is geographically a cold arid desert region of northern India; characterized by hostile environmental conditions, barren rocks, low temperature and high altitude. Human settlement and agriculture is confined between 2500 m and 4500 m above mean sea level. Poor precipitation and low temperature are the main factors impeding crop cultivation in this region. Though agriculture provides a range of staple foods (wheat, barley etc.) including vegetables viz. cabbage and cauliflower, yield is limited and dependant on trench cultivation methods. There is an increasing need to develop vegetables that are tolerant, if not resistant, to cold in an effort to help sustain agriculture at higher altitudes (Sarad Nidhi *et. al,* 2004).

The Defence R & D Organization Life Sciences Lab i.e. Defence Institute of Bio Energy Research (DIBER) in collaboration with Defence Institute of High Altitude Research (DIHAR) took the first step in this direction and opted for the development of genetically engineered vegetable crops, particularly tomato that are tolerant to low temperatures for cultivation at high altitude, cold arid regions of Ladakh to fulfill the requirements of services and local populace. Conventional breeding techniques for cold tolerance in tomato have been unsuccessful due to lack of tolerance gene source in cultivable tomato germplasm. Thus in an effort to develop cold tolerant tomato cultivars, the transgenic approach would be the preferred strategy available. Osmotin is a stress responsive 24KDa protein adapted to NaCl and desiccation that accumulates in cells during osmotic stress. Osmotin is known to be induced by at least ten signals, some of them being UV, salinity, drought, wounding, Abscisic acid (ABA) and cold. Global research has revealed that osmotin induces cold protection in olive trees by affecting programmed cell death and cytoskeleton organization (Angeii and Altamura, 2007). Also over-expression of osmotin results in accumulation of proline, a known osmoprotectant that helps tolerate abiotic stress (Sarad Nidhi *et. al*, 2004; Barthakur *et. al.*, 2001). The transgenic tomato harbouring osmotin gene can tolerate low temperature in comparison to control under laboratory conditions. The developed transgenic tomato lines under evaluation in containment conditions (with prior permission from IBSC and

Plants after an exposure to 2.5°C

intimation to RCGM) have performed to endorse the cold tolerance bioassays conducted in laboratory conditions. Selected transgenic line tolerated temperature as low as 2.5° C and survived significantly more than its counterparts in the containment of DIHAR, Leh.

This is the first report in India wherein a transgenic vegetable crop has been evaluated in a high altitude containment facility at 3486.5 m. Cold tolerant tomato in this region will help to uplift the socio-economic status of local farmers and ensure round the year availability of fresh tomato in this region.

DIBER now plans to move forward with toxicity assays of the promising transgenic line prior to seeking permission from RCGM and GEAC for open field trials.

Acknowledgements: The authors are thankful to Dr. K.C. Bansal, Principal Scientist, NRCPB, IARI, New Delhi for providing the osmotin gene construct. They acknowledge the support extended by Dr. D. Goyary, Dr. S. Anandhan, Dr. Raghwendra Singh and Dr. Mohammad Arif, DIBER, Haldwani during the evaluation study of transgenics.

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SCIENCE OF THE MONTH

N.S. Arun Kumar

MAY 2011

May 1: NASA is preparing a sophisticated new observatory, designed to study the relationship between the saltiness of Earth's oceans and the planet's climate, for its launch into orbit next month. The Earth-observing Aquarius/SAC-D mission will measure the salt levels, or salinity, of the ocean surface, and the subsequent interactions between ocean circulation, the water cycle and other drivers of the planet's climate. Link: http://www.nasa.gov

May 2: A rumor is floating around the Physics community that the world's largest atom smasher may have detected a long-sought subatomic particle called the Higgs boson, also known as the "God particle". The controversial rumor is based on what appears to be a leaked internal note from physicists at the Large Hadron Collider (LHC). It's not entirely clear at this point if the memo is authentic and some physicists say the note may be a hoax. Link: http://public.web.cern.ch/public

May 3: The Indian Space Research Organisation (ISRO) has built a supercomputer, which will be India's fastest (220 Trillion Floating Point Operations per second). Named Satish Dhawan Supercomputing Facility, it is located at the Vikram Sarabhai Space Centre in Thiruvananthapuram. The supercomputer, which has been named SAGA-220 (Super-computer for Aerospace with GPU Architecture-220 TeraFLOPS), would be used for solving complex aerospace problems. Link: http://www.isro.org

May 4: The National Geophysical Research Institute (NGRI) in Hyderabad will drill an 8-kilometer-deep borehole in Koyna, a region in western India to study earthquakes. The project, to be done in collaboration with the International Continental Scientific Drilling Programme, will be the forth such earthquake observatory. Similar boreholes have been drilled on the Kola Peninsula in Russia; in Bavaria, Germany; and in the San Andreas Fault in California. Link: http://www.ngri.org.in

May 5: Fifty years ago, on 5th May, 1961, NASA astronaut Alan Shepard became the first American to go into space. Shepard became a true American hero at a time when it looked like the United States was losing the race to explore space. With Yuri Gagarin already back on Earth after his orbital flight into space, it looked like the United States was technologically inferior to the Soviet Union when it came to getting humans into space. Link: http://en.wikipedia.org/wiki/Alan_Shepard

May 6: Mark your calendars for November 8, because that's when a massive asteroid will sweep past the Earth. The asteroid called 2005 YU55 has a diameter of 1,300 feet and will approach the planet at 0.85 lunar distances. Due the object's size and whisking by so close to Earth, an extensive campaign of radar, visual and infrared

observations is being planned. Because of its size and proximity to Earth, it has designated the space rock as a "potentially hazardous" asteroid. Link: http://minorplanetcenter.net/iau/mpc.html

May 7: Scientists of Bhabha Atomic Research Centre (BARC) have developed a Digital Radiotherapy Simulator, a device to locate tumours and aid radiotherapy planning and verification. The Digital Radiotherapy Simulator helps in identifying the organs at risk and in localizing the cancer-affected tissues. The first machine with the Radiotherapy simulator has been installed by BARC in Indian Red Cross Society Hospital, Nellore, Andhra Pradesh. Link: http://www.barc.ernet.in

May 8: India is moving towards formally joining a mega global initiative aimed at constructing the world's largest and most sensitive radio telescope that will help explore unknown territories in science. As many as 67 organizations from 20 countries are involved in building the 1.5 billion Euro telescope known as Square Kilometre Array (SKA). It will be a gigantic radio telescope comprising 3,000 dish antennas, each about 15 mt wide, spread over a distance of 3,000 km. Link:http://www.skatelescope.org

May 9: High quality images of the Indian landmass and other countries beamed by India's remote-sensing satellite, Resourcesat-2, were presented to Prime Minister Manmohan Singh in New Delhi by the Indian Space Research Organization. The images covered New Delhi, Surat, Bareilly and Dubai. ISRO on April 20, put three satellites in orbit, India's Resourcesat-2, a joint Indo-Russian satellite called Youthsat and another satellite named X-Sat of Singapore. Link: http://www.isro.org

May 10: A massive radio telescope in rural West Virginia has begun listening for signs of alien life on 86 possible Earth-like planets. The giant dish this week began pointing toward each of the 86 planets - culled from a list of 1235 possible planets identified by NASA's Kepler space telescope - and will gather 24 hours of data on each one. The mission is part of the SETI project, which stands for Search for Extra Terrestrial Intelligence, launched in the mid-1980s. Link: http://www.seti.org

May 11: India is moving towards constructing the world's largest and most sensitive radio telescope known as Square Kilometre Array (SKA) that will help explore unknown territories in science. As many as 67 organizations from 20 countries are involved in building the 1.5 billion Euro telescope. Last month, nine nations, including China established the SKA founding Board at a conference in Rome. India, however, could not sign in the letter of intent due to an administrative problem. Link: http://www.skatetelescope.org

May 12: Indian government has constituted a high level committee under principal scientific advisor R. Chidambaram to develop technologies to protect vital government portals and online resources. The Defence Research and Development Organization official also said the Defence Ministry had deliberations with auto majors like Tata and Mahindra to design a vehicle like the

US High Mobility Multipurpose Wheeled Vehicle (HMMWVor Humvee) used by American forces. Link: http://drdo.nic.in

May 13: A team of international researchers, led by Prof. Zander Myburg from the Department of Genetics and the Forestry and Agricultural Biotechnology Institute (FABI) at the University of Pretoria (US) has succeeded in sequencing the complete genome of tree species, *Eucalyptus grandis*. It took four years for a team of 130 researchers from 18 countries to complete the genome sequence and annotate more than 40,000 genes contained within it. Link: http://www.phytozome.net/eucalyptus.php

May 14: The first-ever genetic study of the Great Indian Bustard (*Ardeotis nigriceps*) has revealed that this ground bird has the least genetic diversity among several endangered species. The study was conducted by scientists at the Wildlife Institute of India (WII), Dehra Dun. The extremely low genetic variability within the birds was the result of the phenomenon called "bottleneck event", ecologists believe. The study is published in the journal *Conservation Genetics*. Link: http://www.springerlink.com/content/105709

May 15: NASA has successfully launched the space shuttle Endeavour into orbit for its final flight. The launch was from the Kennedy Space Center for its 25th and final mission. The mission's crew is headed by Commander Mark Kelly. Endeavour will deliver the Alpha Magnetic Spectrometer (AMS) and two S-band communications antennas to the space station. The mission will last 16 days. Originally, the space shuttle was scheduled to launch on April 19. Link: http://www.nasa.gov

May 16: A new species of giant dinosaur has been found in the province of Shandong, China. The new species, described as a close relative of *Tyrannosaurus rex* has been named *Zhuchengtyrannus magnus*. It is estimated to be about 11m long and 4m tall, weighing close to 7 tonnes. It is believed to have existed in North America and eastern Asia during the Late Cretaceous Period that dated back about 65 to 99 million years. Link: http://english.ivpp.cas.cn/au/bi

May 17: In a statement to mark the occasion of World AIDS Vaccine Day, observed on May 18 every year, India's Union Science and Technology Minister Pawan Kumar Bansal said that strategic global partnerships should be created to address scientific challenges in the path of the discovery of an AIDS vaccine. The first World AIDS Vaccine Day was observed on May 18, 1998 and the tradition continues today. Link: http://www.iavi.org.in

May 18: A three-day wild life census began in Kerala today after a gap of nine years. Along with more than 2,000 officials, over 600 volunteers from across the state are taking part in the census. The census is being conducted in the 35 forest divisions of the state. The World Wildlife Fund (WWF) and the Kerala Forest Research Institute (KFRI) are also participating in the census process. It was in 2002 that such a survey was held for the last time in the state. Link: http://www.kfri.org

May 19: Famed physicist Stephen Hawking said in an interview with the *UK Guardian*

published on Monday that he rejects the idea of heaven, calling it a 'fairy story' for people afraid to die. Hawking also wrote in his 2010 book 'The Grand Design' that he believes God was not 'necessary' for the creation of the universe and that 'spontaneous creation', instead explains existence. Hawking's words have created a stir among the believers (of God) all over the world. Link: http://www.hawking.org.uk

May 20: Today is Endangered Species Day observed by conservationists and others as a way to keep the spotlight on efforts to save and restore animal and plant species in trouble. The US Postal Service last week unveiled its new "Save Vanishing Species Stamp" featuring an Amur tiger cub. The stamp, which will go on sale in September, is a joint effort of the postal service, the World Wildlife Fund and other conservation organizations. 2011 is World Turtle Year too. Link: http://www.stopextinction.org

May 21: Giving a boost to its communication services, India today successfully launched its advanced GSAT-8 satellite on board Arianespace rocket from Kourou in French Guiana. The 3,100 kg GSAT-8, was hurled into space by European launcher in a 31-minute mission on Ariane 5 rocket. ISRO's Master Control Facility at Hassan in Karnataka has confirmed the reception of signals from GSAT-8 and taken charge of the command and control of the satellite. Link: http://www.isro.org/scripts/futureprogramme.aspx

May 22: The world's first cloned cat called Copy Cat or "CC" for short, is now nearly 10 years old and has three kittens. The Texas A&M University researcher Dr. Duane Kraemer who helped create Copy Cat said "CC" was one of 80 embryos created for the University's project, but she was the only one to develop into a full-term pregnancy once she was transferred to a surrogate mother. Copy Cat was born on December 22, 2001. Link: http://www.wowzone.com/clonecat.html

May 23: Scientists have documented four new species of Caecilians, Goa Caecilian, Nadkarni Caecilian, Paresh's Caecilian and Mhadei Caecilian, making Goa a hotspot of these legless amphibians. Parag Rangnekar, a researcher, Omkar Dharwadkar, a wildlife enthusiast and Manoj Borkar documented 34 species of dragon flies not known earlier in Goa. Goa University botanists, M.K. Janarthanam and others documented a new plant *Dipcadei goaense* in Rivona in 2007. Link: http://goaenvis.nic.in/biodiversity.htm

May 24: A US-based geophysicist of Indian origin Krishan Khurana at the University of California, and his colleagues have found out the first direct evidence of a vast ocean of hot magma in the interior of Io, the innermost of Jupiter's four largest moons. The scientists analyzed the records of the Galileo mission, and observed that Io has a global sub-surface magma layer. The findings are there in the journal *Science*. Link: http://www.sciencemag.org/content/early/2011/05/13/science.1201425

May 25: The Energy and Wetland Research Group (EWRG), Centre for Ecological Sciences (CES) and Indian Institute of Science (IISc) have jointly mapped the

solar hotspots of the country. The Solar hotspots, found based on the exploitable potential using high resolution global isolation data from the US National Aeronautics and Space Administration (NASA), has found that the country's favourable geographical location has made it one of the best locations for solar energy. Link: http://wgbis.ces.iisc.ernet.in/energy

May 26: Kudremukh National Park(KNP) has been granted an approval as a Tiger Reserve by National Tiger Conservation Authority(NTCA). With this approval, KNP has become the sixth tiger reserve in Karnataka and 41st in the country.Located at the tri-junction of Dakshina Kannada, Udupi and Chikmagalur, KNP is one of the largest expanses of grassland shola ecosystem in the mid-western ghats of Karnataka. Link: http://projecttiger.nic.in

May 27: The moon's interior may contain 100 times more water than previously thought, perhaps as much as the Earth's interior has, a new study has claimed. The finding came from researchers from Case Western Reserve University who analyzed the volcanic samples of the ancient lunar crust. In fact, the measured quantities, could be as high as the water contained in the Earth's upper mantle.If this is the case, it challenges a long-held theory about the moon's formation. Link: http://www.case.edu

May 28: Nature Publishing Group is pleased to announce the launch of a series of affordable, high quality interactive textbooks in college-level science. The first textbook in the series, *Principles of Biology*, intended for the majors introductory biology course, will be available to the market on September 1, 2011. *Principles of Biology* is a high quality digital reinvention of the textbook. It uses more than 175 interactive lessons to help students master basic concepts. Link: http://www.nature.com/nature_education/index.html

May 29: The World Science Festival returns to New York City on June 1-5, 2011 with an array of science programmes. Scientific minds are joined by renowned artists and influential thinkers for a five-day celebration of science through discourse and debate, dance and theater, film, music and the visual arts. This science happening has something for everyone, from invigorating discussions, to events for young scientists and their families, to performances and exhibitions. Link: http://worldsciencefestival.com

May 30: A total lunar eclipse will be visible in India in the late hours of June 15.It will be visible in southern Asia, Africa and Australia and it is the first of two lunar eclipses in 2011 and the third of all eclipses to occur throughout the year. The eclipse can be best viewed in the northern-most region of the 'entire-eclipse zone' in central Asia, as well as Eastern Europe and north-eastern Africa. A partial solar eclipse will also happen on June 2. However it will not be visible in India. Link: http://eclipse.gsfc.nasa.gov

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Proteomic Analysis on Ethnobotanically Important Dioecious Medicinal Spice crop *Piper longum* L. by MALDITOF-MS

Dr. P. Manoj, Dr. M. Saravanakumar and Dr. P. Ravichandran

Abstract

Data from spike proteome analysis using Matrix Assisted Laser Dissorption Ionisation-Time of Flight Mass Spectrometry (MALDITOF-MS) were used to analyze the proteomic differences among male and female plants of *Piper longum* (Thippali). The resulted spectra were converted into binary matrix consisting of protein data sets and genetic similarity values were calculated with the Free Tree software and Jaccard's Coefficient of Similarity. The presence of certain proteins in the extracts was identified by checking their masses in online database. The presence of 2.8 kd and 15.82 kd proteins in the female plants may possibly serve as a marker to identify female populations at the seedling stage and help planting with a balanced ratio of male and female plants to achieve higher yield from the productive females. The present report on detection and presence of such proteins as markers in determination of female plants in *Piper longum* is first of its kind.

Introduction

Piper longum L. (Piperaceae), the Indian long Pepper, is an ethnobotanically important medicinal plant and serve as a major spice (Sivarajan and Indira, 1994). *Piper* species have a pantropical distribution and are most commonly found as understory of tropical rainforest. The wide diversity of its characteristic features as well as the medicinal importance of the genus makes it an obvious model for studies on genetic diversity. India is probably the centre of origin for about 110 species of Piperaceae (Karthikeyan, 2000). The genus *Piper* in India has 50 species, only two of which are monoecious and the remaining dioecious (Hooker, 1890; Santapau and Henry, 1994). Among the dioecious species 26 are endemic to the Himalayan region and eight species are endemic to the peninsular region (Nayar, 1996). There are 16 species reported from Kerala and 19 species from Tamil Nadu (Henry *et al.*, 1987; Sasidharan, 2004).

P. longum is an aromatic, slender, sub-scandent herb or occasional climber with perennial woody roots, creeping under shrub, growing generally in the areas of hotter and humid climate. The erect shrub has a thick, jointed and branched rootstock. The stems are jointed. Leaves

are numerous, 6.3 to 9.0 cm long, with broad rounded lobes at the base, dark green and glabrous above, pale and dull beneath. Fruits occur in solitary, pedunculate, fleshy spike 2.5 to 3.5 cm long, 5 mm thick, ovoid, oblong, erect, blunt, blackish green in colour and shiny. Odour is aromatic and taste is pungent. Minute achlamydeous flowers are closely packed in the fleshy axis of spikes. Male flowers are naked and bear two short stamens. Female flowers too lack perianth and bear a short carpel consisting of very short style with three to four lobed stigma and unilocular ovary. The male and female plants are morphologically very similar till the formation of spikes (Banerjee, *et al.,* 1999). They mainly differ in the morphology of their spikes. Male spikes are longer (2.5 - 7.5 cm) and slender than the shorter (1.5 - 2.5 cm) and thicker (0.5 - 0.7cm) female spikes. The herb has got very pungent fruits, which are black in colour and are used with condiments while serving liquor (Aliyar and Kolammal, 1966). The long Pepper crushed juice is useful in the affections of eyes and in intermittent fever (Rheede, 1668). Long Pepper has high demand for its medicinal properties and for its use in ayurvedic and traditional system of medicine in the treatment of respiratory tract diseases in humans (Viswanathan, 1995).

Genetic diversity studies have been widely carried out used for varietal identification, breeding programmes and cultivation. Assessments of genetic similarity of various crops and species have been performed using morphological data, quantitative genetics DNA studies (Rodriquez, *et al.,* 1999) and proteome analysis (Posch *et al.*, 1994; Posch *et al.*, 1995; Campbel, 2000). In this genomics era, researchers are turning to methods of analysis to determine protein functional information on a large scale with high quality results. Functional proteomics has evolved as a need to understand and investigate expressed proteins of an organism (Washburn and Yates, 2000). Protein analysis and characterization has been done by mass spectrometry which is further applied to protein structure studies to understand functional proteomics (Tabb *et al.*, 2000; Gygi *et al.,* 2000) and DNA sequencing (Koster *et al.*, 1996).

Mass spectrometry offers advantages over gel electrophoresis separation and various forms of hybridization, particularly for automated rapid and large-scale DNA and RNA screening. The use of electrophoretic mobility of fluorescence of a label is only an indirect measure, but mass is an intrinsic property of the molecule, as a result mass spectrometric assay are fundamentally more accurate. The nuclear genome contains most of the genetic information of a plant in a set of chromosomes, each composed of a single DNA molecule. Genomes of different organisms vary in terms of total DNA content (genome size), ploidy level, chromosome number, total recombination distance, nature and number of functional genes. At the molecular level, chromosomes are

composed of DNA and proteins. The DNA carries the genetic information, while the protein compounds provide enzymatic and structural function, important to the replication, recombination and segregation of the chromosome. The main part of the chromosome contains a mixture of coding sequences (exons) intragenic and intergenic non-coding sequences (introns), regulatory sequences, tandem repeats (mainly minisatellites, microsatellites and VNTRs) and other dispersed repeats. Tandem repeats have been used in genomic research and have shown a great potential in genome mapping (Filho *et al.,* 2004).

This article describes a method for spike proteome analysis using Matrix Assisted Laser Desorption Ionisation-Time of Flight (MALDI-TOF) mass spectrometry. This is done to assess the genetic diversity among six male and six female *Piper longum* accessions from South India as part of developing marker system in screening dioecious plants. MALDI-TOF mass spectrometry data obtained from spike proteome analysis was used to characterize the genetic differences among male and female plants. The resulted spectra were converted into binary matrix consisting of protein data sets and genetic similarity values were calculated with the Free Tree software and Jacard's coefficient of similarity (Filho *et al.*, 2004).

MALDI mass spectrometry measurements were performed on a time-of-flight instrument (KRATOS). Ions, operating in positive linear mode formed by a pulsed UV laser beam (nitrogen laser, l = 337 nm), were accelerated to 20 kv. The use of this beam did not denature proteins during MALDI measurements.

Materials and Methods

Vegetative stage plants as well as developing spikes from 12 *P. longum* (six male and six female) accessions were used for the protein studies. The samples were obtained from the germplasm collection maintained in the Institute's nursery. Twenty five mg of ground (using liquid Nitrogen) leaf samples and immature spikes from each accession was mixed with 500 ml of buffer (50% acetonitrile, 0.1% TFA) and extraction was carried out individually for 12 hrs at 4°C on a shaker. The samples were spun at 18,000 rpm for 20 min. and the supernatant transferred to clean tubes and dried by lyophilisation. The dried pellet for each accession was re-suspended on a 0.1% TFA solution (1 ml). They were kept at 4°C until used for the mass spectrometry analysis. The analysis was performed by MALDI-TOF mass spectrometry and it was calibrated with a polypeptide standard Angiotensin (1046.5423 D). Sinapinic acid (3, 5 dimethoxy-4 hydroxy cinnamic acid) i.e., saturated solution in acetonitrile and water (50:50 v/v), was used as the matrix. Samples were diluted with a 0.1% trifluoroacetic acid aqueous solution. 5 ml of the diluted sample solution was mixed with the same volume of matrix solution, and 1 ml of the resulting matrix was deposited on a stainless steel sample holder and dried before inserting into the mass spectrometer. External mass

calibration was carried out using $[M + H]^+$ ions of bovine Insulin, Cytochrome C and horse myoglobin at m/z 5734, 12361 and 16952 respectively.

The data revealed by MALDI-TOFMS spectrum analysis of the spike protein extracts were converted to a binary coded matrix in which the presence of a specific protein with a certain molecular mass was coded as **1** and the absence of the same protein was coded as **0**. Since no mass standards were used during analysis, only relatively high differences between two masses were regarded as distinct proteins. The data in the binary matrix was used to calculate all pair wise genetic similarities among the different accessions and between male and female plants. Genetic similarities were expressed as Jaccard's Coefficient of similarity using the following formulae:

$$GS = \frac{A}{A + B + C}$$

GS = genetic similarity between any two samples (**i** and **j**)

A = number of proteins present in both **i** and **j**

B = number of proteins present in **i** and absent in **j**

C = number of proteins absent in **i** and present in **j**.

The genetic similarity matrix was then used to construct a dendrogram which showed the relationships among the plants and is graphically represented as a tree. MALDI-TOF spectrometry was used to analyze the differences in size of protein complexes among male and female populations.

Results

The mass spectrometry analysis of the 12 long pepper accessions resulted in a binary matrix containing 51 protein data sets. Twenty six different mass spectra presented variations in the pattern of expressed proteins (Figs. 1 and 2) within the investigated range of mass values (1,000 to 20,000 Da). The presence of certain proteins in the extracts was identified by checking their masses using online databases. Reproducibility was checked and the degree of similarities and differences between all accessions were calculated using the variability of these data sets. Accessions consisted of six male

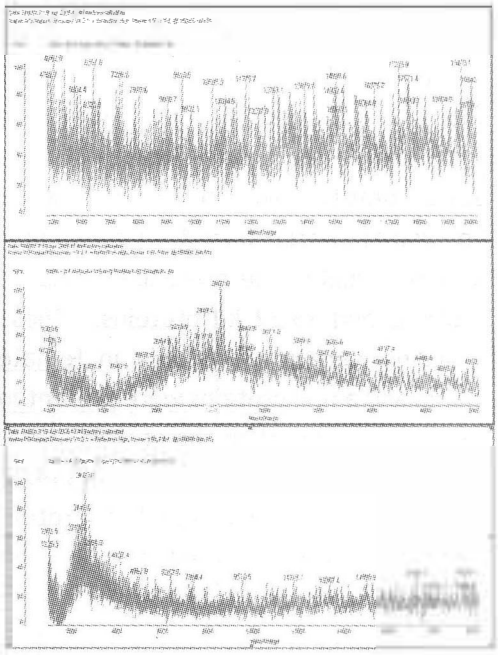

Fig. 1. MALDI-TOF mass spectra of spike protein extract from Piper longum female accessions. The mass values are indicated in daltons

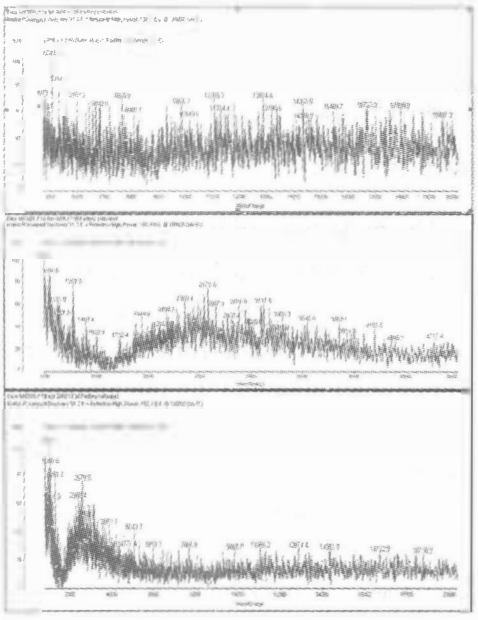

Fig. 2. MALDI-TOF mass spectra of spike protein extract from Piper longum male accessions. The mass values are indicated in daltons

named as M1 (Calicut), M2 (Idukki-14), M3 (Thenmala), M4 (Vellayani), M5 (Guruvayur) and M6 (Kuttiady) and six female named as F1 (Trichur), F2 (Achenkoil), F3 (Idukki-13), F4 (Mala), F5 (IISR, Calicut) and F6 (Idukki-10). Mass spectrometry database (Structural Mass Spectrometry Group Protein Mass Software) search based on molecular weight revealed the presence of 2.8 kd proteins and 15.82 kd proteins. These proteins were present only in female plants and a few proteins were present in male plants. Based on the protein size it was found that some of the proteins (4.01 kd), ferrodoxin and homeobox protein (2.336 kd) were observed in all the samples analyzed.

The genetic similarity in the proteome of male plants ranged from 0.4071 to 0.9041 and that of female plants from 0.4051 to 0.7050. Between male and female the similarity ranged from 0.2000 to 0.3033. The average similarity value among male plants was 0.6600 and female 0.5400 and between male and female plants the indices was 0.2300. The male and female plants formed two distinct clusters unlike the observation in the preliminary RAPD analysis (data not given) with 35 long pepper accessions where the dendrogram showed five clusters (Fig. 3). Among the male accessions, M1 (Calicut) is distantly related with other accessions. In the case of female accessions F6 (Idukki -10) and F1 (Trichur) were found to be distantly related whereas F2-F3 (Achankoil and Idukki -13) and F4-F5 (Mala and IISR) are closely related. The above experiment was aimed at checking whether the MALDI technique could be used as an alternative method to investigate the genetic variations among various accessions.

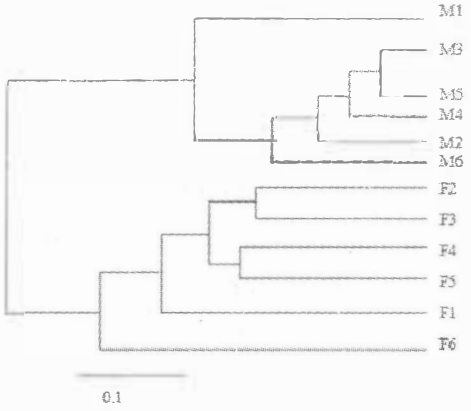

Fig. 3. Dendrogram constructed from the Genetic Similarity (Jaccard's Coefficient) data illustrating the relationships among Piper longum accessions revealed by their MALDI-TOF Spike Protein Profile

Discussion

Filho *et al.* (2004) did a similar study in Capsicum using 12 plants from

Capsicum annum, *C. chinense*, and *C. frutescens* where, 23 protein data sets of mass range 1,500 to 15,000 Da, were found and a similarity matrix and dendrogram was constructed. Posch *et al.* (1994; 1995) analyzed 102 proteins in *Capsicum annum* genotypes and compared the results with 2-D electrophoresis analysis and found that MALDI-TOF MS represented a much faster and cheaper methodology with the generation of results in a few minutes. The number of protein data sets in this study is likely to be under-estimated, because the mass spectrometry analysis only allows a specified range of masses to be analyzed each time and need further analysis of a wider range of masses for better genetic diversity assessment.

The presence of distinctive proteins in either sex could indicate specific functional characteristics, perhaps specifically and directly related to sex determination. The detection of predicted peptides from nucleotide sequence, from both male and female spikes, and the prediction of post-transcriptional modifications by looking for their predicted protein mass spectra (Fig. 1 and 2), is an additional application of this methodology. Based on the genetic similarity coefficients (Table. 1) obtained from the data on presence and absence of proteins in male and female plants a dendrogram was constructed. The dendrogram revealed two distinct clusters of male and female plants (Fig. 3). The similarity index obtained here was higher than that of RAPD analyses. MALDI spectrometry may be applied directly to protein complexes without purification prior to MS analysis. This in combination with genetic engineering may help in unraveling the role of the various proteins present in male and female plants of *P. longum*. The presence of 2.8 kd and 15.82

Table. 1. Pair-wise Jaccard's genetic similarity coefficients of the six male and six female long pepper plants based on spike protein mass profile as measured by MALDI-TOF

	M1	M2	M3	M4	M5	M6	F1	F2	F3	F4	F5	F6
M1	1											
M2	0.5040	1										
M3	0.5103	0.6000	1									
M4	0.5000	0.6057	0.6000	1								
M5	0.6000	0.7026	0.9041	0.7008	1							
M6	0.4071	0.8033	0.7037	0.7014	0.7021	1						
F1	0.2068	0.2019	0.2040	0.2030	0.2061	0.2020	1					
F2	0.3007	0.2070	0.3051	0.2020	0.2071	0.2070	0.5000	1				
F3	0.3002	0.3010	0.2061	0.2067	0.3010	0.3030	0.5045	0.7050	1			
F4	0.3018	0.3020	0.2030	0.2071	0.2050	0.3010	0.5040	0.5040	0.6007	1		
F5	0.2074	0.2030	0.2000	0.2050	0.2060	0.2060	0.5090	0.4067	0.5000	0.6056	1	
F6	0.3033	0.2030	0.2050	0.2051	0.2008	0.2020	0.6050	0.5070	0.4051	0.6081	0.6007	1

M- male plants, F- female plants

kd proteins in the female plants may possibly serve as a marker to identify them at the seedling stage and help planting with a balanced ratio of male and female plants to achieve higher yield from the productive females.

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Extraction and Antimicrobial Screening of Biological Fibres from Selected Plant Species (*Typha angustifolia* Linn. and *Agave cantala* Roxb.)

P.R. Krishna Chaitanya, D. Devichowdary, K. Sireesha, S. Kanaka and R. Bharath Kumar

Typha angustifolia Linn., a common plant of wetlands, is an unexploited taxon which can be used as a good source of food, medicines and fibres. *Agave cantala* Roxb., is commonly cultivated worldwide as an ornamental plant. It has since naturalised in many regions and grows wild in Europe, South Africa, Australia, Newzealand and in India.

Typha and Agave plant species have been also identified as, a few of the most promising domestic, commercial fibre yielding plants from the ancient literature sources (Anonymous 1948-76; Chopra, *et al.*, 1956) and they have been used by the various primitive communities for making cordage, nets, mats, hats, tuff roofs etc.

It is with this background, the present study has been taken up for a preliminary screening of antimicrobial activity of various fibre components of the above biological fibre yielding plants. The results are mostly in conformity of the medicinal uses and they are discussed in detail in the article. This is a first hand information and sparse information is available in literature sources related to its other uses.

Selected plant species for experimental studies

Typha angustifolia Linn.: *Typha* (meaning "marsh" in Greek) is a monocot genus of the monotypic family Typhaceae with about 12 species distributed in the tropical and temperate regions of the world in marshes and wetlands of varied depth. They are able to occupy pond and lake margins, fresh and brackish marshes, ditches and reservoirs contaminated with industrial wastes. Some of the taxonomically identified species of the genus are supposedly the hybrid of two different species growing side by side in the same stand, adapting to shallow and deep water logged areas respectively. Known as "long-bracted cattail" or "small reed-mace" in English, "Kab" in Bengal, and as "Pater" in North Bihar of India and Nepal Terai region, it is found as a prevalent and dominating plant in the shallow wetlands in the country-sides of North Bihar in the months of July-October.

Uses of *Typha angustifolia*

Uses of Leaf and Shoot Fibres of *Typha angustifolia*: Folk people of the Mithila region have been using the long fibrous leaves of the plant to weave 2-2.5 inch-thick strong mattresses ("Shitalpati") for use as a coarse kind of bed-sheet since olden times. Fibrous leaves and stems are used for thatching, screens, wickerwork, ropes, stuffing, insulation for jacket, chair making, hats etc. Gupta (1994) listed these products from *Typha* species as important non-wood forest products in Asia in his report to FAO (UN). Plant leaves of *T. angustifolia* may probably be used with memory foam and high resiliency base foam to create an innovative and modern bed mattress with help from modern technology.

Edible, Medicinal and other Reported uses:

a) Edible: *T. angustifolia* roots rich in starch are eaten raw or boiled or dried roots are pulverized into a powder and then used as a thickener in soups or added to cereal flours to make biscuits, breads, cakes etc. in many parts of the world (Facciola, 1990). Shoots (rhizome) and flowering stems are likewise used elsewhere (Low, 1989). Pollens are yet another source of protein which is used as additive in making bread, porridge etc. (Facciola, 1990).

b) Medicinal: The leaves are diuretic (Duke and Ayensu, 1985). The pollen is astringent, desiccant, diuretic, haemostatic and vulnerary and, used in the treatment of nose bleeds, haematemesis, haematuria, uterine bleeding, dysmenorrhoea, postpartum abdominal pain and gastralgia, scrofula and abscesses. The seeds are haemostatic. The rootstock is supposedly astringent and diuretic (Chopra *et al.*, 1986).

In China, "Puhuang" is the traditional drug obtained from *Typha* plants (Gao *et. al*, 1998). Plant parts of both *T. angustifolia* and *T. latifolia* are used for medicinal applications even in angina, cystitis, diarrhea, urethritis, menstrual cramps, burns, insect bites, rash and wounds. Pollens are dusted on bleeding wounds to prevent the flow of blood. Extracts of *Typha angustifolia* were also found to lower serum cholesterol levels in artherosclerotic rabbits.

Other Uses

c) Heavy metal tolerance: *Typha angustifolia* has shown high degree of tolerance towards heavy metals and, accumulation of metals like Cd, Cr, Cu, Fe, Mn, Ni, Pb and Zn found in distillery wastewater. Thus, the plant has been strongly recommended for bioremediation of the general and industrial wastes.

d) Waste treatment: According to FAO assessment report for sewage and industrial waste (effluent) treatment (2007), emergent macrophytes take up large amounts of inorganic nutrients (especially N and P) and heavy metals (such as Cd, Cu, Hg and Zn) as a consequence of the growth requirements. Cooper *et al.* (1988) estimated that the land area considered necessary for treatment of preliminary-treated sewage

in Europe is at 2-5 m^2 per population equivalent to achieve a secondary effluent quality.

e) Biotechnological applications for enhancing phytoremediation aspects: Modern genetic engineering approaches may be used to optimize the phytoremediation capability of a plant to dispose off contaminants/metals from contaminated sites.

Chemical constituents of *Typha* species

Plant contains three steroids [b-sitosterol, (20S) 24-methylenlophenol, and stigmast-4-ene-3, 6-dione] and three fatty acids [a- linolenic, linoleic, and an unidentified C_8H_2]. Roots are rich in polysaccharides. Flavonoids are present in shoots and flowering heads. Xu *et al.* (1986) isolated seven crystalline compounds from the inflorescence of *Typha angustifolia.* These compounds were vanillic acid, E-p-hydroxy-cinnamic acid, protocatechuic acid, E-Propenoic acid-3-(hydroxyphenyl)-2,3-dihydropropyl ester, succinic acid, p-hydroxybenzaldehyde and D-mannitol. Medicinally active principles in *T. angustifolia* have been mainly identified as flavonoids (Gao *et al.,* 1998; Xi and Li, 2000).

***Agave cantala* Roxb.**

The Century Plant or Maguey (*Agave cantula*) is an agave originally from Mexico but cultivated worldwide as an ornamental plant. It has since naturalised in many regions and grows wild in Europe, South Africa, Australia and New Zealand.

It has a spreading rosette (about 4 m wide) of gray-green leaves up to 2 meters (6 ft) long, each with a spiny margin and a heavy spike at the tip. Its common name derives from its habit of only occasionally flowering, but when it does, the spike with a cyme of big yellow flowers, may reach up to 8 meters (25 ft) in height. Cultivated varieties include the 'Marginata' with yellow stripes along the margins of each leaf, 'Medio-picta' with a central white band, 'Striata' with multiple yellow to white stripes along the leaves, and 'Variegata' with white edges on the leaves.

Medicinal and other useful aspects of *Agave cantala* species

a) Medicinal uses : The plant, is also known as the American aloe, although it is in a different family from the true aloes.

The stems of the plant excrets sap, when it is chopped with a knife. It consists of a sweet liquid called 'agua miel' ("honey water"). This may be fermented to produce the drink called 'pulque' (a viscous alcoholic beverage), which may then be distilled to produce 'mezcal' (a popular drink in Mexico - taken befor breakfast - control diseases such as hypertension and diabetes and is even an aphrodisiac). Agave syrup (also called Agave nectar) has recently been marketed as a healthy natural sugar substitute.

b) Other uses: The leaves also yield fibers, known as pita, which are suitable for making rope, matting, coarse cloth and are used for embroidery of leather in a technique known as piteado. Both pulque

and maguey fibre were important to the economy of pre-Columbian Mexico. Production continues today to a much lesser extent.

Materials and Methods

Vignan University were the presents study was undertaken, has a campus with a good number of plants. It includes landscaping gardens, exotic elements and natural forest elements, rare and endemic categories of trees, shrubs, herbaceous members, climbers and a good number fibre yielding plants like Typha, Agave and Sanseveria. An inventory experimental study was conducted on selected most promising domestic, commercial fibre yielding plants, Typha and Agave, for the duration of two months. Methodology was adopted for the above mentioned studies are as per standard literature sources. The work has been taken up in connection with the internal students mini projects funding resources. The chemical composition of the plant species (Phytochemistry), medicinal and economic uses were checked with the standard literature sources.

Extraction of fiber components from plant parts

Extraction of fiber components through mechanical process (choping, crushing, grinding and maceration of plant parts, 1-2 inch in size) and separation of fiber components by several washings with tap water and sterilized distilled water Later these fiber components are collected and shade dried in separate vessels for 1-2 days. Thereafter, these fiber components are separately soaked in organic solvents like methanol and acetone for 24hrs (equal quantities to V/W).The conical flasks are placed on water bath at 45-50°C till the extracts get concentrated and cooled down. Then the supernatant has been taken into the separate test tubes and aseptic paper disks are placed into the test tubes. These extracts containing test tubes are kept in a sterile cool place for conducting screening tests of their antimicrobial activity responses.

Antimicrobial screening tests for plant fibre extracts

a) Media and Microorganisms: The suitable culture media was prepared by dissolving the below mentioned ingredients for the respective microorganisms. The contents were autoclaved at 15 lbs for 15 min. Both Gram +ve and Gram -ve bacterial species are taken as test organisms for antibacterial activities of plant extracts.

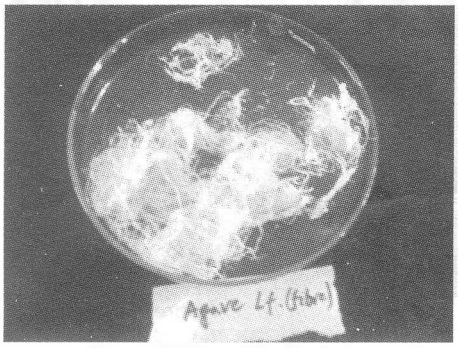
Medium for bacterial species: Nutrient Broth/ Nutrient Agar Medium (NBM/NAM) ingredients

Peptone	–	10 g
Beaf extract	–	10g
NaCl	–	5g
Distilled Water	–	1000 ml
Agar	–	15 g
PH	–	7

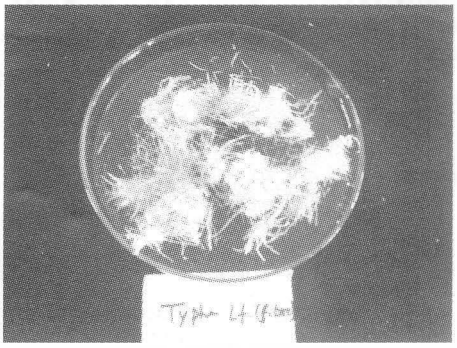
Microorganisms - Bacteria

Gram +ve *Bacillus*: *Bacillus subtilis*, known as the hay bacillus or grass bacillus, is a Gram +ve , catalase +ve bacterium commonly found in soil. *B. subtilis* is not considered as a human pathogen; it may contaminate food but rarely cause food poisoning.

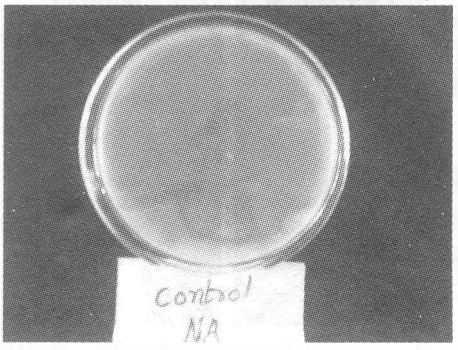
Antimicrobial Inhibition zone response of *Typha angustifolia* and *Agave cantala* test samples



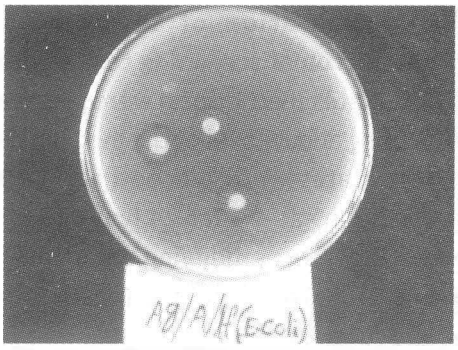
Fibre components extracts of *Agave cantala* Leaf



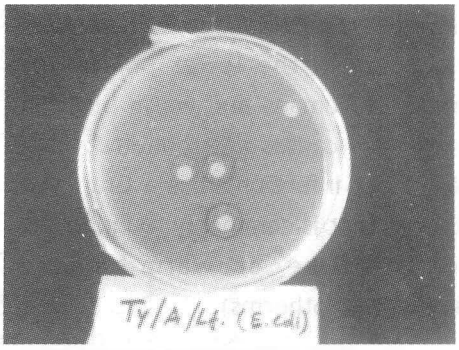
Fiber components extracts of *Typha angustifolia* Leaf



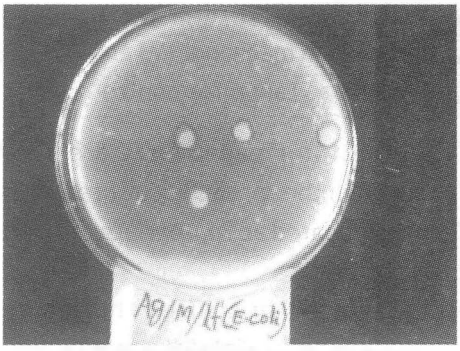
Control -Nutrient Agar Medium Test Plate



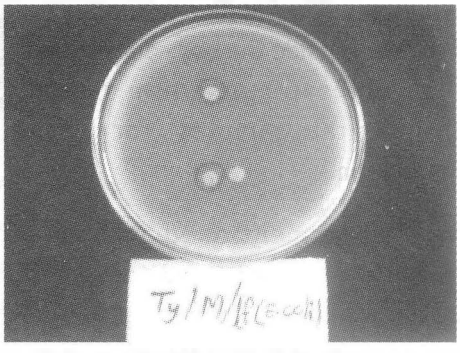
Agave cantala Leaf Fibres (in Acetone Extract) (*E.coli*)



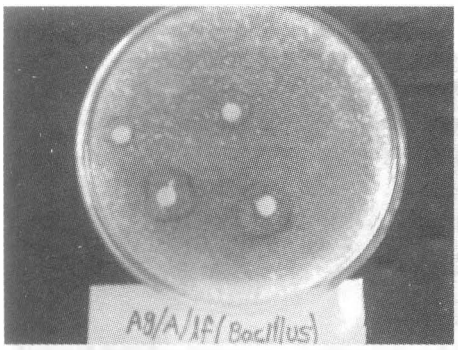
Typha angustifolia Leaf Fibres (in Aectone Extract) *(E. coli)*



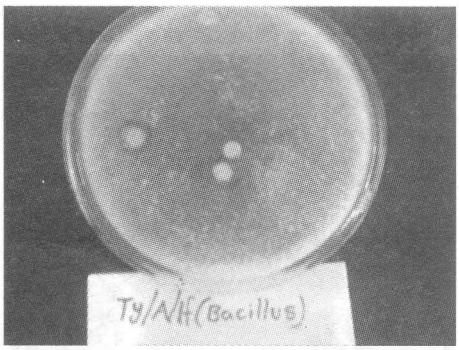
Agave cantala Leaf Fibres (in Methanol Extract) (*E. coli*)



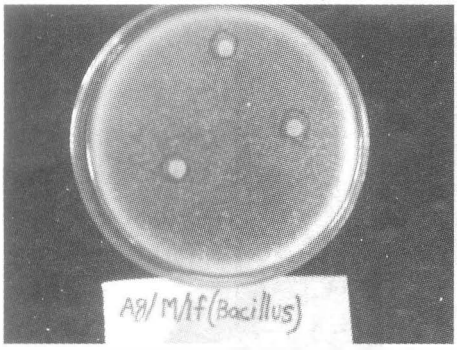
Typha angustifolia Leaf Fibres (in Methanol Extract) *(E. coli)*



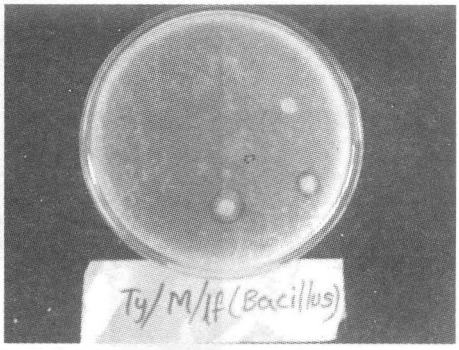
Agave cantala Leaf Fibres (in Acetone Extract (*Bacillus subtilis*)



Typha angustifolia Leaf Fibres (in Acetone Extract) *(Bacillus subtilis)*



Agave cantala Leaf Fibres (in Methanol Extract *(Bacillus subtilis)*



Typha angustifolia Leaf Fibres (in Methanol Extract) *(Bacillus subtilis)*

Gram - ve *Escherichia coli*: *Escherichia coli*, occurs in the lower portion of intestine of humans and warm blooded animals and causes gastroenteritis and urinary tract infection. It is a Gram -ve bacterium that is commonly found in the lower intestine of warm-blooded organisms (endotherms).

E. coli are not always confined to the intestine, and their ability to survive for brief periods outside the body makes them an ideal indicator organism to test environmental samples for fecal contamination.

The above mentioned microbial cultures are maintained on their respective media in slants at 4^0 C (as per standard procedures).

b) Preparation of test plates for antimicrobial screening tests: The agar test plates (Petridishes) were prepared by pouring about 15 ml of the medium. These test plates were placed under aseptic conditions at 4^{o}C for 24 hours to control sterility after solidifying the media (NAM and SAB). The inoculums (bacteria 24 hrs and fungi 48 hrs) homogenous suspension was uniformly spread on their respective test plates. The filter paper discs were prepared in methanol (M) and acetone (A) extracts as taken for control.

The filter paper discs are carefully placed in the spreaded culture test plates and incubated at appropriate temperature for bacteria at 37^{o}C for 24 hrs. and fungi 30^{o}C for 48 hrs. After the incubation period, the test plates are examined for

inhibitory zones. All determinants were made at least in triplicate for each of the test organisms in different extracts.

Results and Discussion

A total of 24 samples of methanol and acetone soxhlet extracts belonging to the two plant species (Root, Leaf, Spike etc.) were subjected for antimicrobial screening. All the 24 samples exhibited positive inhibition zone activity. The observations are recorded and they have been categorized into high or maximum zone (cognizable inhibitory zone) (i.e.15-20 mm inhibition zone) in four samples (A/M extracts), moderate inhibition zone of expression in 15 samples (A/M extracts) (i.e. 10-14 mm inhibition zone) and minimal inhibition zone of expression in five samples (i.e. < 10 mm inhibition zone) i.e. 20.83% in the total of test samples (24 plant A/M extracts). In a nut-shell

Antimicrobial inhibition zone response of *Typha angustifolia* and *Agave cantala* test samples

Name of the plant species	Bacterial species	Plant extracts (Plant part)	Media	Inhibition zone
Typha	*E. coli*	Acetone (Lf)	N.A	12cm
Typha	*E. coli*	Acetone (Spk)	N.A	14cm
Typha	*E. coli*	Acetone (Rt.)	N.A	11cm
Typha	*E. coli*	Methanol (Lf)	N.A	11cm
Typha	*E. coli*	Methanol (Spk)	N.A	10cm
Typha	*E. coli*	Methanol (Rt.)	N.A	12cm
Typha	*Bacillus subtilis*	Methanol (Lf.)	N.A	12cm
Typha	*Bacillus subtilis*	Methanol (Spk)	N.A	9cm
Typha	*Bacillus subtilis*	Methanol (Rt)	N.A	11cm
Typha	*Bacillus subtilis*	Acetone (Lf)	N.A	12cm
Typha	*Bacillus subtilis*	Acetone (Spk.)	N.A	0cm
Typha	*Bacillus subtilis*	Acetone (Rt)	N.A	8cm
Agave	*Bacillus subtilis*	Methanol (Lf)	N.A	11cm
Agave	*Bacillus subtilis*	Methanol (Fl.st)	N.A	10cm
Agave	*Bacillus subtilis*	Methanol (Rt)	N.A	10cm
Agave	*Bacillus subtilis*	Acetone (Lf.)	N.A	20cm
Agave	*Bacillus subtilis*	Acetone (Rt)	N.A	19cm
Agave	*Bacillus subtilis*	Acetone (Fl.st)	N.A	15cm
Agave	*E. coli*	Acetone (Lf)	N.A	15cm
Agave	*E. coli*	Acetone (Fl.st)	N.A	14cm
Agave	*E. coli*	Acetone (Rt)	N.A	14cm
Agave	*E. coli*	Methanol (Lf.)	N.A	8cm
Agave	*E. coli*	Methanol (Fl.st)	N.A	8cm
Agave	*E. coli*	Methanol (Rt)	N.A	9cm

considerable inhibition zone of expression was observed in 19 samples out of 24 test samples (24 plant A/M extracts) i.e.79.17% in the total of test samples. 10-20 mm of either Gram +ve (*Bacillus)* or Gram-ve (*E. coli*) bacterial species.

The inhibitory activity of acetone extracts are comparatively more than those of methanol extracts. The acetone and methanol extracts have shown high inhibitory activity in Gram +ve bacteria and comparatively less in both Gram -ve bacteria.

Antimicrobial inhibitory expression is observed in extracts of both in *Typha angustifolia, Agave cantala* A/M solvents respectively. Upon critical study and to summarize the antimicrobial activity test, it is noticed that out of 24 samples with positive response the cognizable inhibition could be observed (i.e.15-20 mm) in 4 samples (A/M extracts) only.

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CONSERVATION OF BIODIVERSITY - INEXTRICABLY LINKED WITH HUMAN WELFARE

Dr. S. Sandilyan, Dr. K. Thiyagesan and Dr. R. Nagarajan

United Nations General Assembly declared 2010 as the International Year of Biodiversity. This announcement indicated the importance of global biodiversity conservation. In general, biological resources are the untapped capital of any country. By nature's gift, India is blessed with a good biological resources, it is mainly due its wide and varied altitudinal range, extending from sea level up to summit of the Himalayas. In addition, the country possesses a highly varied climate and associated diversity which provides a platform for the country's biodiversity. India is one among the 25-mega biodiversity countries of the world and for its credit it has 350 species of mammals, 1224 species of birds, 197(+) species of amphibians, 2546 species of fishes, 57,548 species of insects and 46,268 species of plants. But for the past few decades the biodiversity has been facing several threats, in the form of habitat loss and fragmentation, deforestation, pollution, disease, introduction of exotic species, over-exploitation, poor management and illegal wildlife trade which lead to spiraling of Indian biodiversity. Human society gets several benefits through the existing diversity. We get several models and colour patters by way of mimicking the animal and plants. The plants are the treasure house of medicines for several incurable diseases, but yet there is a glamours lacking in the above said fields in our country especially that we don't have a dossier of medicinal plants. With and without our knowledge we are loosing the diversity day-by-day. So it is the need of the hour that we should obey the Article 51-A (g) of the Indian Constitution which enjoins that: "It shall be the fundamental duty of every citizen of India to protect and improve the natural environment.

In recent times several countries realized that biological resources are the untapped capital for a country (Anonymous). Several national and international research organizations and research and development laboratories portrayed biodiversity as the most commercially important natural resources like oil or gold (Prathapan and Dharamarajan, 2009). But we should keep

it in mind that biological resources are not an inexhaustible resource. Once lost, it may not be possible to resurrect.

India has confounding biodiversity wealth which is mainly due to its different altitudinal range, extending from sea level up to summit of the Himalayas and also possess varied climate, soil, topography, cultural and ethnic diversity which support the country's biodiversity wealth. Moreover the vast areas (3029 million hectares) of our country support types of different habitats which laid a platform for the biodiversity richness which make India as one of the most important mega biodiversity nations of the earth. For instance in the case of Indian wetland habitats, the natural wetlands in India consists of the high altitude Himalayan lakes, followed by wetlands situated in the flood plains of the major river systems, saline and temporary wetlands of the arid and semi arid regions and coastal wetlands such as lagoons, backwaters, estuaries, coral reefs, marine wetlands and mangrove swamps (Thiyagesan and Nagarajan 1995, Nagarajan and Thiyagesan, 1996; Sandilyan, 2009). So due to the availability of different habitat types, naturally the biological diversity is higher in Indian sub-continent. For its credit India is one among the 25-mega biodiversity countries of the world which harbors 350 species of mammals, 1224 species of birds, 197(+) species of amphibians, 2546 species of fishes, 57,548 species of insects and 46,268 species of plants (Sandilyan *et. al.,* 2008a). Ironically the country is squandering the natural resource in several ways and especially for the past few decades the biodiversity has been facing several threats, in the form of habitat loss, habitat fragmentation, deforestation, pollution, diseases, introduction of exotic species, over-exploitation, poor management, illegal wildlife trade and eco-tourism which lead spiraling of Indian biodiversity (Sandilyan *et al.,* 2008 a, b). For instance illegal wildlife trade alone pushed several common species in to the brink of extinction in India. In recent years there has been a massive decline of our national animal 'tiger' because of the illegal hunt for its bones, skin, blood and claws (Sandilyan *et al.*, 2008a). Furthermore several reports stated that 100 million tones of fishes, 1.5 million live birds and 44,000 tones of medicinal plants are illegally exported just in a single year (Sandilyan *et al.*, 2008a). Moreover, the rural population who are living under poverty condition depends on the biological resources to meet 90% of their needs, (Srivastava and Singh, 2009). This is one of the major causes for a huge decline of our biological resources. The forgoing review clearly indicates the plight of Indian biodiversity.

Why to Conserve Diversity ?

As mentioned earlier, undistributed biological resource are the real assets of any country. Moreover, the richness of biodiversity naturally accelerates the productivity of any kind of ecosystem, and enhances the ecosystem to possess the ability to prevent and recover from all kinds of disasters including both natural

and man made. It is obvious that an immense diversity ensures the healthiness and sustainability of an ecosystem. Basically ecosystems act as a treasure house of genetic resource. Sustainable use assures production of nutritional food, and economic security of a country. Prathapan and Dharamarajan (2009) emphasized that biological resources, being the raw material for the biotechnology industry, will be the key to achieve potential economic success in the near future of any country.

In this article the importance of biodiversity of the unexplored and poorly studied fields *via.,* Biomimicary, Forensic entomology and Medicinal plants are discussed. In these fields our focus and knowledge are not as good as western countries. In order to acquire and strengthen the knowledge in these areas we should conserve the unique biological diversity of our country.

Forensic entomology

Entomology is a branch where we study about the biology of insects and Forensic entomology is a science or discipline to study the crimes by using insects. For instance by observing the insect, larva, and maggots, available in the corpse, we can unveil the hidden truth of a death or murder (Sandilyan, 2008a).

Naturally hundreds of insect species are attracted by a dead body, especially flies and beetles. Even in one case 400 species of insects have been recorded in a pig's dead body during its several decaying stages. It indicates that different species of insects get attracted by corpse during different phases of degradation (Sandilyan 2008a). Insects are attracted by cadavers immediately after death and often with in minutes. In some cases, the adult flies may be present near a dying person or animals before their actual death (Sandilyan 2008a).

In several criminal cases, the time of death gives some vital clue to trace out the criminal/culprit. We could exactly calculate the death time based upon the diversity, density and stages (adult, larva, and pupa) of insects present in the body (Sandilyan, 2008a)..

Indian Scenario

Forensic Entomology is in existence for more then 150 years (Sandilyan 2008a) but our country was not aware about this field till recently. Even world wide, the number of experts working in the field is limited (nearly 60 only). This discipline requires the cooperation of the other discipline like pathology, anthropology, ecology and medicine. To get meaningful and exact conclusions the results should be discussed with the expert in the above mentioned fields. But in India it is very hard to believe that we don't even have the list of nacrophagous insects and their distribution (Sandilyan, 2008a).

Biomimicry

The word biomimicry is a combination of two words namely 'Bio - Life' and 'Mimesis - Imitation'. It is a rapidly growing field. The main motto of the field is to observe and study nature, natural models, systems and other life activities, and use

them as model for artificial creative designs. In other words the objective of the field is to study the nature more closely and imitate it for the well being of human society. Biomimicry is also known as biomimetics, and bionics (Sandilyan 2008b).

We can get designs, solutions and answers for several knotty problems by simply watching nature. Even watching the anatomical and physiological structure of several organisms besides evolutionary process may give solutions to several burning problems. Nature - inspired design is practiced by several people globally. The well known personalities in this field are Wright Brothers and Leonardo Davanci (Sandilyan, 2008b).

Lotus Effect

The self cleaning nature of the lotus is called 'lotus effect'. The plant achieves this property by the tiny wax crystals on the surface of the leaves. The leaves of lotus remains pristine even in a highly contaminated environment. The micro structure of the leaf surface allows even a small amount of rain or fog to clear the surface. This inspired characteristic feature of lotus leads to the invention of an exterior house paint. If we coat this paint on buildings we need not clean and repaint the buildings frequently and can save time and money.

Indian Scenario

Yet we did not start the research in biomimicary. If you want to be an achiever in this field go and sit quietly at least in front of your garden and observe nature patiently and question yourself and read books and research articles to clear your doubts and do research on your favorite flora or fauna, and think how to and where to apply the noval outcome of your observation and ideas in our day to day life (Sandilyan, 2008b).

Medicinal Plants

Plants have been used in the traditional healthcare system from time immemorial, particularly among the tribal and rural communities. World Health Organization (WHO) listed out 20,000 medicinal plants globally (Gupta and Chadha, 1995). India contributes 15-20% among them (Singh, 2000). Another report of the WHO emphasized that 80% of the population in the developing countries depends directly on medicinal plants for its medicines (Mukhopadyay, 1988). Dikshit (1999) stated that 2000 different kinds of drugs from plants are used in India to cure different diseases.

Ironically the dossiers of medicinal plants are not available in our country. Most of the important details of medicinal plants are descended through generations of oral folklore among the family members or the particular community (e.g. medicines for Jaundice practiced in some families of southern Tamil Nadu villages like Parravi near Karikal region of Pondy Union Territory). The tribal people are the treasure house regarding the medicinal plants and they have the profound knowledge regarding the medicinal plants of their area where they live. According to Srivastava and Singh (2009) India has

53 million tribal people belonging to 550 communities living in various pockets of India. So, the traditional knowledge is heaped in the diverse areas of our country. It is the bounded duty of the Indian Government to implement bioprospecting and benefit sharing concepts adopted by Cost Rica's National Biodiversity Institute.

Conclusion

If we conserve the existing biodiversity, we can do wonders in various scientific fields especially biomimicry, forensic entomology and prepare the traditional medicines which are the need of the hour. Furthermore United Nations General Assembly declared 2010 as the International Year of Biodiversity to protect and preserve the unique biological diversity of our earth. It is worth to quote here the Article 51-A (g) of the Indian Constitution which enjoins that: "It shall be the fundamental duty of every citizen of India to protect and improve the natural environment". And also we should keep in mind the words of our Father of our Nation Mahatma Gandhi "The earth provides enough to satisfy every man's needs but not for anybody's greed".

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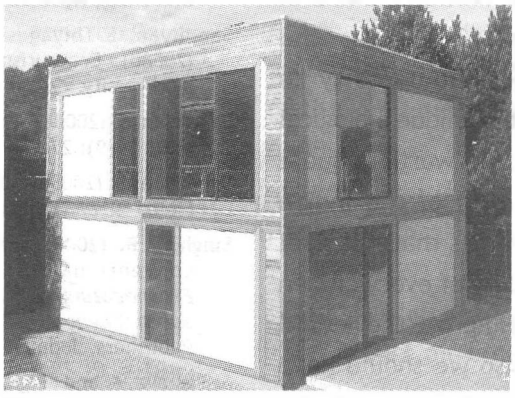
The house of straw strong enough to withstand huffing and puffing - and a hurricane

N.G. Renganathan

A straw house is created by a team of builders at US. This house is supposed to withstand any amount of huffing and puffing. This house is also supposed to withstand hurricane. The environment-friendly house was built with straw bale panels. This is expected to pave way for future straw mansions. Tests were performed for withstandability of these buildings from hurricane force wind.



This house, built from straw and hemp panels, can withstand winds as strong as 120mph. The BaleHaus@Bath building was built by industrial partners ModCell to assess the performance of straw as a sustainable building material. The two-storey building was officially opened by Grand Designs presenter Kevin McCloud last year. The research team, led by Professor Pete Walker, Director of the University's Centre for Innovative Construction Materials, has been monitoring the house since October last year for thermal performance and humidity level. The team has now tested the structure of the house for resisting winds of up to 120mph. It used hydraulic jacks which pushed horizontally against the walls with a total force exceeding four tonnes, equivalent to the dynamic force of a hurricane. During the tests, the walls moved no more than four millimetres under peak loads, well within design requirements and as predicted. Straw is a very environment-friendly building material. This material is also renewable. It is also a by-product of farming. A number of questions may be raised from the point of view of safety. The first question is whether it is fire proof. The second question that may be asked is whether it is durable. It is said to reduce CO_2 emissions by 80%. The government itself undertakes some projects on this to test its durability and sustainability. If the results are good then these renewable materials are a realistic option for building on a large scale.

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SCIENCE INDIA QUIZ

Send the correct answers to Science India office or to arsmenon@gmail.com/scienceindia2010@gmail.com latest by 20th July, 2011. A science book as prize awaits you. If there are more than one correct entries, the winner will be selected by draw of lots

- Editor

SCIENCE INDIA QUIZ NO. 20

1. Mica is used in electric bulb because it is a -------
2. A metal which forms an amalgam with other metals
3. Plants take nitrogen in the form of -------
4. Total number of bones in an adult human being
5. The chief constituent of gobar gas
6. Short-sightedness can be corrected by using -------
7. The sweet-smelling solvent used in nail polishes
8. Sir Humphry David in 1808 isolated this chemical element
9. Chemical name of Lime Stone
10. Science of examining drugs

Answers to Quiz No. 19

1. Tungsten 2. Mixture of ammonium chloride and sodium nitrate 3. Stem 4. Bone marrow 5. Hydrocarbons 6. Blood 7. Acetobacter 8. Bamboo 9. Calciferol 10. Davy

The winner is Master P.M. Vipin, St. Thomas High School, Palai
CONGRATULATIONS !!!

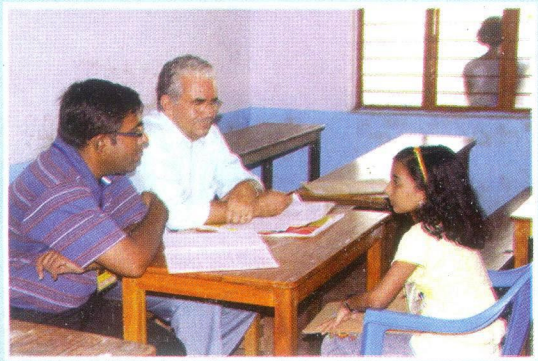
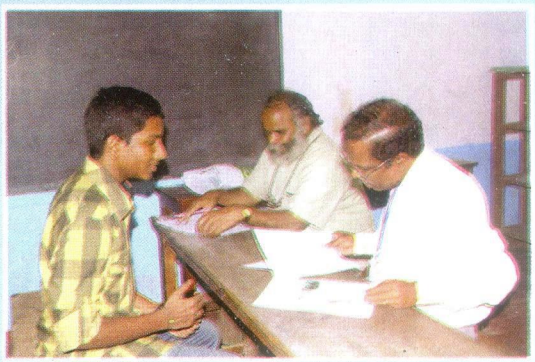
10th Sastra Pratibha Matsaram

Swadeshi Science Movement (SSM), the Kerala Chapter of VijnanaBharati is a popular Science Movement that aims at the development and propagation of science at all levels; right from popular to professional and research level. SSM organizes several programmes for students in Kerala and these programmes are well appreciated by the cross section of the society. SSM has been conducting a unique science talent contest for the school students, 'Sastra Pratibha Matsaram' by name, since 1999 aiming at igniting the talents of students with the heritage of Indian science and scientific awareness. This is a grand event with a participation of about 8,000 to 12,000 students in a single contest. Following its success, similar talent search contests were held in Pune, Delhi and United Arab Emirates. Evidently, this has turned out to be the decade's success story. Eminent scientists and academicians like our Past President Honorable Dr. A.P.J. Abdul Kalam, Prof. V.N. Rajasekharan Pillai, Vice Chancellor, IGNOU, Prof. Yash pal, Dr. Vijay Bhatkar are among those who guided the venture.

The Vision of the 10th Sastra Pratibha Matsaram was to focus attention of younger generation to the rich scientific heritage of the country and to trigger a catalytic action in developing scientific temper in the society and also to encourage students by providing opportunities for nurturing their talents so that they are motivated to take up science as career.

Students of Kerala State studying in classes 5 to 12 in streams like CBSE, ICSE, State Govt. syllabus etc. attended the 10th SPM. They were grouped into Sub Juniors (5,6), Juniors (7,8), Seniors (9,10) and Super Seniors (11,12). Exams were held in English and Malayalam medium. The syllabus consisted of Indian Contribution to science (70%), Science syllabus of respective classes including Mathematics (20%) and Current awareness in science (10%). A book detailing Indian contributions to science was supplied gratis to those who registered for the contest.

The selection was a three tier process. In the first tier, tests consisted of objective type questions only and the second tier test consisted of both objective and descriptive type questions. The students who qualified at the second tier examination participated in the final round which was a two day Science Camp, at which students were put to group tasks, debates, reasoning tests, interview etc.

The winners at each level were given proficiency certificates and books and the final 'Sastra Pratibhas' were given medals, proficiency certificates, mementos, books and cash prize.

Glimpses of the Science Camp